POPULAR SCIENCE

AUGUST · 1931

25 CENTS

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SPEEDBOATS RACE STANDING STILL

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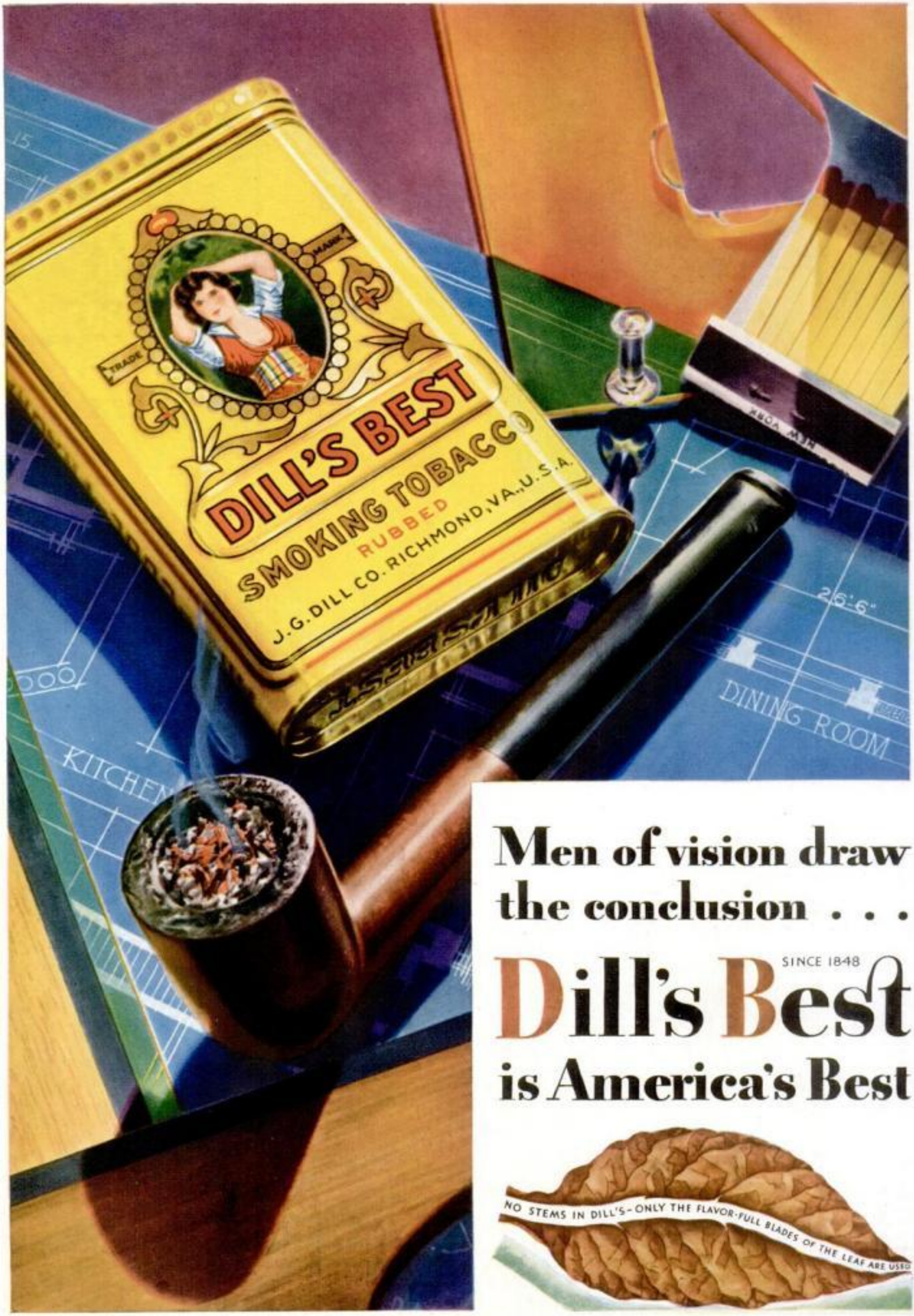

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POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

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NEW DEVICES FOR THE HOME

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Is the Market Full of TEMPTING BARGAINS?

By LEON MEADOW, *Financial Editor*

ON SATURDAY, April 18th, Bob Connery dropped in to see Steve Endicott at the latter's office. Both men were rival automobile salesmen, and quite friendly. After comparing notes on the number of sales each had made during the past month, their talk gradually drifted into a discussion of the depression, as most conversations ultimately do these days.

"I'm convinced that, with the market so low, there must be a lot of real bargains on the list, if you only know how to pick them. Conditions have reached the point where they have just about had their full effect on the market," said Connery, lighting a cigarette.

"It was public participation in the first place," he continued, "that sent prices up like a sky-rocket—and it has been the withdrawal of this support that's largely contributed towards bringing them down with such a crash. Now there is probably less general public demand for stocks than there was *before* the 1929 boom, and so I think that that's one good indication that prices are pretty near the bottom."

"Then you think," put in Steve, "that market prices work on the law of supply and demand, just as commodities and clothes do."

"Well, not entirely—but certainly to a large extent since the public became involved in the market. Anyway—whatever the cause—the result is evident. Take the leading companies in the rail, industrial or utility groups—even in the so-called 'depression-proof' food products industry. Why, their stocks are practically selling for a song. It's been years since U. S. Steel or Chase National Bank could be bought at prices that would give you 5% or more return on their dividend rate."

"Things certainly look tempting," admitted Steve. "I wish I could make up my mind about investing that insurance money I just received. Like most everyone, I'm looking for an investment bargain. If what you say is true, they should be plentiful. I wonder if there's a morning paper around here."

"I have one on my desk," answered Connery. "I'll get it." In a few minutes he returned. "I see you're getting right down to business," he added, smiling, as he noted that Endicott had already fetched paper and pencil.

"Oh—thanks," said Steve, "We'll just run over the list and pick the leaders in each group." Remember now that it was April 18th—and here are the selections they made and the market prices on that day:

RAILS	PRICE
Atchison Topeka	170
Baltimore & Ohio	67
Mo. Kan. & Texas	17
New York Central	106
Northern Pacific	45
PUBLIC UTILITIES	
Amer. Gas & Elec.	72
Columbia Gas & Elec.	35
Electric Power & Light	47
Pacific Lighting	58
Standard Gas & Elec.	71
INDUSTRIAL	
General Electric	44
General Motors	43
Sears Roebuck	50
Union Carbide	58
U. S. Steel	132
FOOD COMPANIES	
Beatrice Creamery	74
Borden's	69
Corn Products Ref.	74
General Foods	53
National Dairy	45

"There—now I think that selection covers a fairly representative group of high grade stocks. We picked them not only as leaders, but also because they are stocks which have gone down deepest since the crash. I really believe that they are representative of good, sound stocks which have dropped sufficiently to be quite deflated. From the standpoint of yield, they certainly are more attractive than they have been in years."

"I agree with you," Bob Connery replied. "They certainly look like bargains—and if you believe in the basic soundness of the country, you can buy them now and realize handsome profits later. Which ones are you going to buy?"

"None at present. I'd like to wait a few days before making my decision."

• • •

The next day, Steve Endicott was unexpectedly sent on a business trip by his company and he did not return for about six weeks. One evening—Monday, June 1st, to be exact—he met Bob going home on the 5:57 train.

"Say, Steve," said Bob, after they had settled in their seats, "did you buy any of those stocks we put down that day at your office?"

"No, I didn't. Was called away on business and never got a chance to do anything about it."

"I wonder how you would have made out. Have you still got that list?"

"In my pocket yet, I think. Yes—here it is," said Steve. "Just for information let's compare it with today's prices. Got a pencil, Bob?"

Here are the figures Endicott wrote down next to those put down on April 18th—six weeks before:

RAILS	April 18th Price	June 1st Price
Atchison Topeka	170	135
Baltimore & Ohio	67	45
Mo. Kan. & Texas	17	10
New York Central	106	73
Northern Pacific	45	32
PUBLIC UTILITIES		
Amer. Gas & Elec.	72	49
Columbia Gas & Elec.	35	23
Electric Power & Light	47	30
Pacific Lighting	58	49
Standard Gas & Electric	71	56
INDUSTRIAL		
General Electric	44	36
General Motors	43	31
Sears Roebuck	50	47
Union Carbide	58	44
U. S. Steel	132	85
FOOD COMPANIES		
Beatrice Creamery	74	55
Borden's	69	48
Corn Products Ref.	74	56
General Foods	53	43
National Dairy	45	28

"That's more than interesting!" exclaimed Bob. "If I had bought 100 shares of any one of these stocks, representing America's leading industries, I would have been out anywhere from $300 to $4,700—all in the space of six weeks! Hardly what you'd call a bargain, eh, Bob?"

"I guess not, Steve."

"Well," said the other, "this little story has one moral, and I might have realized it before if I hadn't been so anxious to find a bargain investment. It's simply this: buying stocks today on the strength of what seems to be attractive prices, can prove to be costly. No one knows what *true* and cer-

tain level will finally be reached, and just where stocks will finally stabilize themselves. For the average investor, like myself, it seems to be sheer folly to try picking up stock bargains today. Supposing I buy something that falls off 25 points more in the next six weeks—then, aside from the apparent, actual loss, what indication or assurance have I that that's the limit? And if it should be the limit, perhaps the stock will level itself at that point and never come back! Don't get me wrong—the industries we selected are basically safe and sound. But public participation—with its wild and unreasonable buying and selling orgies—has deprived the market of whatever relationship it formerly bore to business conditions. Now, it fluctuates violently, and independently of conditions that really should affect or control it. The best thing I—or any man of average means—can do, is to stay out of the market entirely."

"You're undoubtedly right," put in Connery. "Now, how will this affect your investment plans?"

"Only in this way—I'll keep the money I have to invest in the savings bank until I can pick up some gilt-edge bonds or highest grade preferred issues—or guaranteed first mortgages that yield more than savings interest. At all odds, the common stock market is no place for a man who has a small amount of money to invest, and who wants a large amount of security behind that investment. It was only luck that prevented me from burning my fingers this time—so, in the future, I'll stay away from the fire altogether."

"That certainly seems to be the wisest policy," said Bob, "and if I had the money to invest—which I haven't—I'd do the same!"

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"The Provident Provider" is a booklet describing a new savings plan which provides a regular retirement income for a man and insurance protection for his family. A copy will be mailed on request by Provident Mutual Life Insurance Company, Philadelphia, Pennsylvania.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

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Guaranteed Advertisements

Popular Science GUARANTEE

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Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

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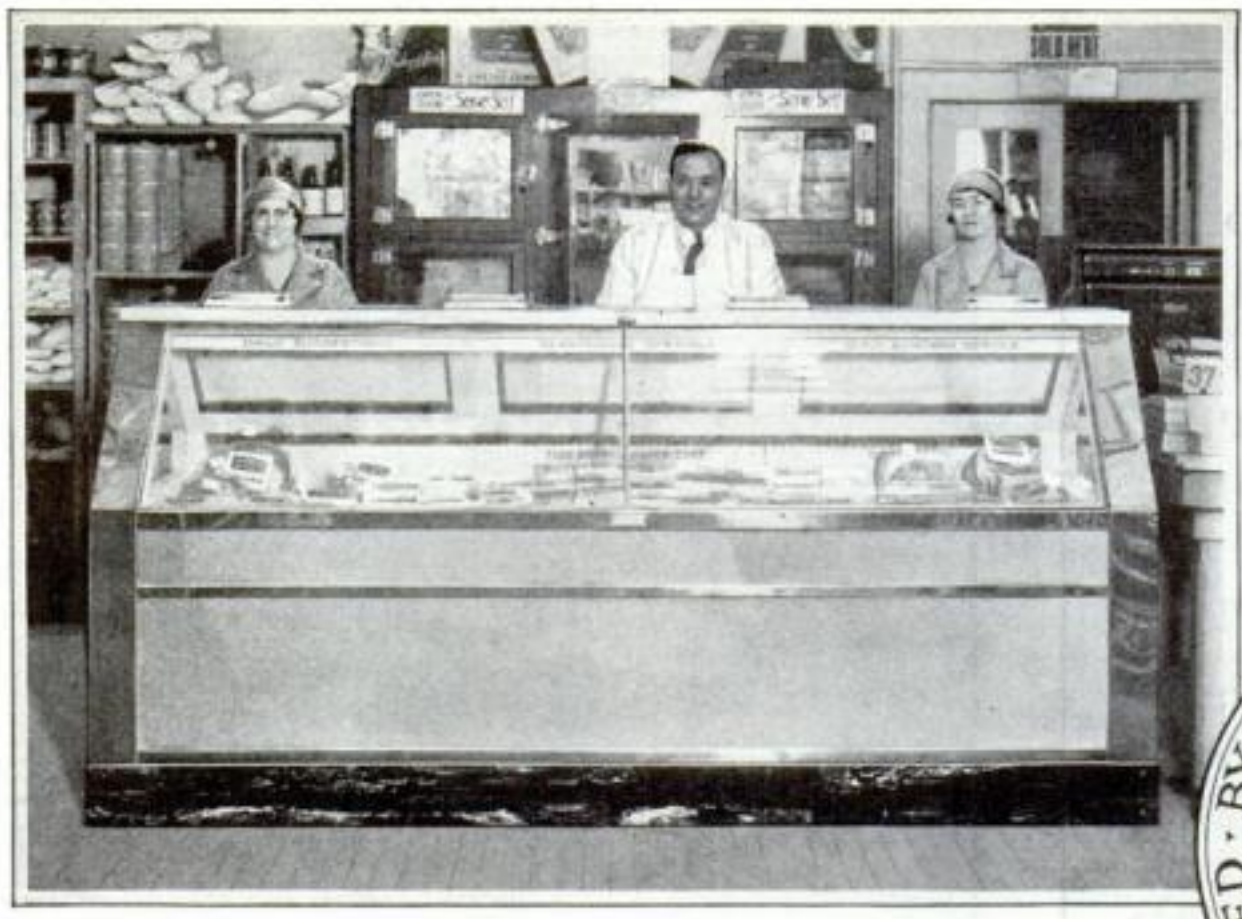
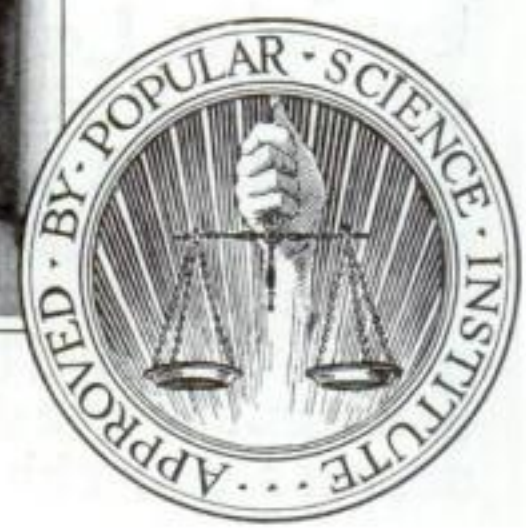


If you live in the city and buy in small quantities frequently, you can let the neighborhood store take care of some of your food storing in their refrigerator, but an ample box of your own is more satisfactory.



Make Your Refrigerator Suit Household Habits

By F. G. PRYOR

Secretary Popular Science Institute

NEXT to getting a refrigerator that is well made, the most important thing to consider is size. It is not only inconvenient to have an undersized refrigerator, but overloading a box raises the temperature and interferes with proper air circulation.

While there are no hard and fast rules that can be set down for everyone to follow, there are certain factors governing this matter of correct size that should be remembered by every refrigerator purchaser.

The habits of the family are what determine the size of the refrigerator even more than the number of individuals in the family. This makes it impossible to say, therefore, that a certain size box is suitable for a family of five any more than it is possible to pick out a particular house and call its dimensions just right for five people.

Take, for instance, the Miller's family —a typical one of five members, including three grown-ups and two children. There is a lot of entertaining done in their house and the refrigerator is always stocked with a great variety of food besides all the milk and plainer dishes for the children. A ten-cubic-foot box, which is usually just about right for families of five, is quite a bit too small for the Millers, and yet their neighbors (five in family, also) down the street get along quite nicely with a refrigerator that has only eight cubic feet of space.

The whole difference is that this latter household is made up entirely of adults and it is a house where there are few visitors and very simple eating habits are the custom. So it is obvious that it is the household's habits, quite as much as size, that determines how big the refrigerator has to be.

Then, too, locality has a good deal to do with it. People living in the city near the stores find it convenient to buy smaller quantities more frequently and their refrigerators do not have the strain put upon them that is the case where a refrigerator is used in the country or smaller communities. That is why you often see a city household of fair size that can get along with a four or six cubic foot box. Often, however, it is not out of preference that such a small box is used but simply because apartment quarters will not permit a more spacious refrigerator.

This matter of space in the kitchen is something that frequently enters into the selection of a refrigerator. When there is just one particular place where the refrigerator can be stored, there is nothing to do but get a box that will fit in that space. Careful study of different manufacturers' catalogs will show that a box can be obtained that will have the necessary dimensions and still be constructed in such a way that the desired food storage space is obtained.

It is advisable, when using a refrigerator of the ice type, to allow for enough space so that the box is not likely to be crowded. It is not possible to crowd an icebox and get really good refrigeration, for the amount of food stored in the box affects the temperature and is liable to bring it up above the 50° point essential to proper food preservation. Mechanical refrigerators can take a somewhat greater load of foodstuffs for the same space because of the cold temperature that can be maintained easily and the active circulation. However, too small a mechanical refrigerator is no economy, for the unit will have to work overtime to maintain the temperature at which the controls are set.

In households where a good refrigerator is installed and has been found to be somewhat too small for the needs of the family, the best thing to do is to keep outside such foods as do not absolutely require storage in a refrigerator (certain vegetables and fruits, for instance) and to purchase smaller quantities at a time of other foods that must necessarily be kept in the refrigerator. Also, care should be taken to place dishes or containers in the refrigerator in such a manner that space between them will permit free air circulation.

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Our Readers Say

Why Not Spell by Sound?

I AM a sign painter confronted with a big problem. The trouble is, that ninety-five percent of English words are misspelled. I mean the wrong letters are used such as C for K and Ph for F and the E at the end of the word when it should be somewhere in the middle or left out altogether, and double letters and silent letters. The words should be spelled by sound. What's the big fool idea of such spelling and then using marks to correct them? Musical notes are printed just as you read them and the dots and dashes in telegraphy are received just as they are sent. It's too bad that human beings do not use enough judgment to spell by sound, which is just as much trouble or less than the present way. The man who invented this spelling has been dead for many centuries, and I hope he gets his eternal punishment. Some may not agree with me but it seems to me that to spell by sound is the correct way, as Theodore Roosevelt insisted many years ago.—P. L., Newton, Kan.

Your Old Magnet Always Weighs the Same

I WOULD like to tell B. McC. that his magnet does not change in weight. No matter where he weighed it, the weight would be constant. What he would weigh, if he performed the experiment suggested, would be the magnet's attractive force. I recognize this problem as one that sunk our class when I was studying physics.—H. K., New York, N. Y.

One Little Grain of Sand

W. F. G., Corona, N. Y., has a theory about tall buildings and I, as a Westerner, have a word to say to him. He thinks that New York skyscrapers will, because of their weight and height, slow up the rotation of the earth, since, as he says, a slight weight on one side of a revolving sphere tends to stop it. New York is no more than a drop in the bucket, hardly more than a wren's feather on the back of an elephant. If W. F. G. will look at a relief map of the United States, he will see that we have nearly a dozen mountain peaks on the West Coast that are over 10,000 feet high, each of which weighs more than the entire city of New York. For example, Mount Tacoma is 14,408 feet high and the Empire State Building is 1,048, not including the spire. Now draw a diagram and compare the two. It is true that a weight on the side of a revolving sphere tends to stop it, but I am afraid a far greater force than we realize spins our earth through space and nothing can stop it.—F. W. S., Tacoma, Wash.

No Love for a Monkey Ancestry

I SEE famous scientists are helping you give your readers a lot of unscientific nonsense. When I read that I felt at first like not renewing my subscription, but as you have not cut out what others have objected to, which happened to be what I wanted left in, I will not ask you to cut out this foolishness for two reasons. First, because I know you wouldn't; and second, because it will do those wise ones some good when they have to admit that they know nothing at all. A man must have a lot of brains to tell people that his father was a monkey. Well, maybe so, but he is more of a monkey than his dad and his offspring are likely to sprout tails and it won't take 125,000,000 years either! People seem to love mystery and superstition. That is why the spirit mediums and the fortune tellers thrive as you showed in a recent issue. And that is why you have to give your subscribers such monkey talk. They like it. Give it to them. I don't have to read it. Please have those wise ones tell your readers just how long ago it was when the little fishworm decided it needed a helpmate. You have been doing pretty well in supplying what your readers want, and I do not have to worry about articles that I do not like. I can just pass them by. I am depending on your curiosity to read this letter before you throw it in the waste basket. Did you ever notice the curiosity of monkeys?—L. R. C., Los Angeles, Calif.

Now, D. J. S., Will You Just Behave Yourself?

IN REPLY to the article written by D. J. S., his stating that his only reason for buying POPULAR SCIENCE MONTHLY is to derive a few laughs from the "babblings" of these so-called scientists (probably because the "babbles" are beyond reach of his mental exertions), seemed very odd to me. If D. J. S. is looking for something laughable, perhaps I could recommend a few funny jokes or cartoons which would be much more amusing and appropriate. To speak of the scientists' theories as being ticklish is absurd in every sense of the word. POPULAR SCIENCE MONTHLY is a book for the man who thinks, and it contains very little humor; in fact the letter by D. J. S. was the only humorous thing in the issue in which it appeared.—C. T., Chicago, Ill.

Another Side of the Same Picture

PERMIT me to congratulate you on securing and publishing the article on "How Man Was Created," by Dr. W. K. Gregory, in the splendid yet simple presentation arranged by him and your staff writer, Michel Mok. I believe that this is easily the most important contribution of its kind yet published, because of its clarity and the manner in which the multitudinous details have been boiled down. It should reach a large number of thinking, intelligent readers, who for the most part are not familiar with this evidence.—H. J. C., Agate, Nebr.

Just a Great, Big Wonderful Story!

I HAVE read your articles about Russia and they make a very wonderful story of the most wonderful achievement ever made by man. I became interested in Russia about eight years ago and have read everything I could get hold of since that time that had the word Russia in it. I am sure POPULAR SCIENCE MONTHLY deserves great credit for so excellent and truthful a presentation of the Russian situation. Some of the conditions the Russians enjoy are: Every Russian is to some extent a banker and a joint owner of all land, minerals, and tools of production. The situation in this country is pitiful. I have 400 acres of wheat that looks A-1. I probably shall get thirty-five to forty cents a bushel for it. The next generation of Russians will inherit a well equipped nation free of debt. We in America must buy our nation back from the bankers, money lenders, and profiteers every ten years. Inside of the next ten years Russia will be saving for its workers the 100 billion a year that we are wasting.—H. B. S., Amherst, Colo.

Here's One to Defend Old Numerology

YOUR editorial on "Radio Rackets" attracts my attention because of your righteous hate of the injustice so clearly set forth therein. Your classification of "numerology" as a "pseudo-science" leads to the offering of a few thoughts on the Exact Science of Numbers. Like yourself, I was born a human question mark, and when some years ago I read for the first time that to the so-called ancients the number three (expressed as III) "was a sacred number," my curiosity was aroused and the resulting WHY? led to some interesting and startling rediscoveries. For example, the number II appears in Newton's formula—"action and reaction are Opposite and Equal," but it was Confucius who connected such effects with a Cause in his formula "the twofold operation of The Ultimate Principle." Thus we have evidence of a Rule of III, or Trinity. As numerology leads to symbology we have symbols of that Rule of III found in a pair of balances with their two opposite and

equal sides and the fixed center which unites them. If the two sides are set in motion we have a symbol of "the third law of motion" as set forth in Newton's formula. It is not generally known that all arts and all sciences are founded on the law of balance.—C. L. R., New York, N. Y.

Keep Your Eye Peeled for This Patent Racket

HAVING been a subscriber and careful reader of your instructive and entertaining magazine for several years, I want especially to congratulate you upon the articles concerning our patent laws and the protection of inventors you published some months ago. In this connection, I feel it my duty to warn inventors, through your pages, against a new patent pirating racket. Some time ago, I perfected an invention and took out a patent. A few days after the patent was issued, I received a letter from a patent shark who brazenly threatened to steal my invention unless I agreed to let him manufacture it on the basis of a ten percent royalty to me. If this arrangement did not suit me, the racketeer wrote, he would "redesign" my invention, manufacture it, and proceed to sell it on his own hook. Naturally, I did not reply. Instead, I wrote to the U. S. Commissioner of Patents, requesting advice. He suggested that I place the case in the hands of my local U. S. District Attorney, and also bring it to the attention of the U. S. Post Office Department. This was done. In addition, I took the matter up with the Better Business Bureau in the city where the patent pirate is located.—H. H. R., Nashville, Tenn.

Our Short Cuts Save Him Much Time

THERE have been many times in the past that I have been able to use the different kinks and short cuts that you show on automobiles, radio, and around the home generally, and have never been disappointed. The other items you print are also good, and I can hardly wait until the next copy of your magazine is on the newsstands.—F. J. G., Rankin, Pa.

Beetle That Fired a Cloud of Gas

SOME years ago in Marion County, Ark., I noticed some beetles busily engaged running in and out under a good sized stone. I turned the stone over and touched one of the beetles with a straw. As soon as the bug felt the straw, it discharged a shot of gas that formed a cloud about four or five inches from the beetles' tail. I touched it again and the same thing happened except the discharge was weaker. I repeated the touch and each time there was a discharge of gas that grew rapidly less and less. An Indian, who was with me, got down on his haunches to watch and as I again touched a beetle the gas was thrown into the Indian's face. He nearly fell over backward and would not repeat the experiment. I have no clear idea of the effect of the gas but I suspect it would blind or paralyze one of the bug's enemies. Can anyone tell me more of these beetles?—J. C. L., Iron Mountain, Mich.

Enough Chemistry for Everybody

THE article, in a recent issue, about the pill box camera certainly was interesting. I don't do extensive photographic work, but I enjoy using my camera to good advantage. It happens that I have such a camera as was described in that article. It will take sixteen pictures on the standard vest-pocket film. Many of the snapshots that I have taken merit enlarging, but I suspected that all sharpness of detail would have to be sacrificed. Dr. Hutchison, I read, has successfully overcome this. Here's hoping that we can have the process in the drug store developing stations soon. Now a word to J. D. McPh. I don't suppose that you can appreciate industrial chemistry when you see it. POPULAR SCIENCE MONTHLY has published plenty of it. I hope that this publication keeps up the good work as it has done for so many years.—C. H. B., Brooklyn, N. Y.

Here's a Boost for Flyer Bellanca

YOUR article on "Tony Fokker, Wizard of Flight," was very timely. I had been wishing that one of my pet magazines would print an article on the life of some airplane designer, so you can imagine my surprise when I found this title staring me in the face. How about something on that little Sicilian, Guiseppe Bellanca? How many people know that during the war he offered to build for the American Government a bombing plane around two Liberty motors with a top speed of 160 M. P. H.? Of course, like all great geniuses, he was trampled underfoot by Big Business. His figures were always on the conservative side. When he promised a ship with a speed of 125 M. P. H., chances were that when it was finished it was five or ten miles faster. This is a direct contrast to many designers whose figures are too hopeful, in the end making the manufacturer satisfied with a speed much lower than they figured. He is one of the greatest, if not the greatest, aerodynamists. Bellanca knows more about how the air flows past an airplane than any man living. These are only a few facts about him. If more are wanted, ask Clarence Chamberlin. By the way, don't pay any attention to those anti-aviation enthusiasts.—M. P. B., Detroit, Mich.

Applause Accepted with Profound Thanks

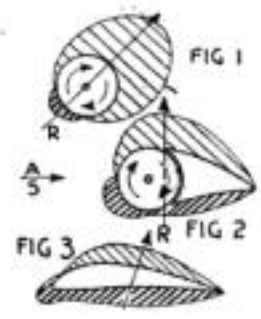
IN "Costly Nuisances Yield Riches," and "Seek Drugs to Save Dope Fiends," in a recent issue of POPULAR SCIENCE MONTHLY, you have attained to that almost impossible thing—a popular article on chemistry. Congratulations.—C. C., Winnipeg, Can.

Our Woodworking Wins His Approval

I THINK that you are putting out one of the finest magazines of its kind that it has been my pleasure to read and work from, and noting one of the letters from readers which appeared in the last issue, find there a suggestion that the articles on carpentry might be eliminated, or at least given less space. Just wish to say that it was those very articles, carpentry and woodworking, that led me to the trial subscription. I think that POPULAR SCIENCE MONTHLY has an appeal to many classes of workers and that it covers the field in splendid style. If the other fellow wishes more special articles on his line of work, no doubt he can obtain them in a technical periodical devoted to that special line. Thus he would not need to interfere with those who enjoy a more varied form of reading. I wish you a continued successful career.—J. H. T., Pitcairn, Pa.

Gives New Airfoil to Clever Inventors

BEING interested in aviation and enjoying the solution of physical problems, I have from time to time solved the aerodynamic problems of various types of airfoils and comparing the characteristics peculiar to them, I have conceived a new type combining the Magnus Effect of the rotor airfoil as developed by Anton Flettner with the aerodynamic action of the standard aeroplane airfoil. The basic idea of my "rotor-foil" is: By inserting a stationary airfoil between the leeward field of excess pressure and diminished pressure of a rotating airfoil of the Flettner type the direction of action of the resultant of the forces of excess pressure and diminished pressure can be controlled by altering the position of the stationary airfoil in the field of diminished pressure.



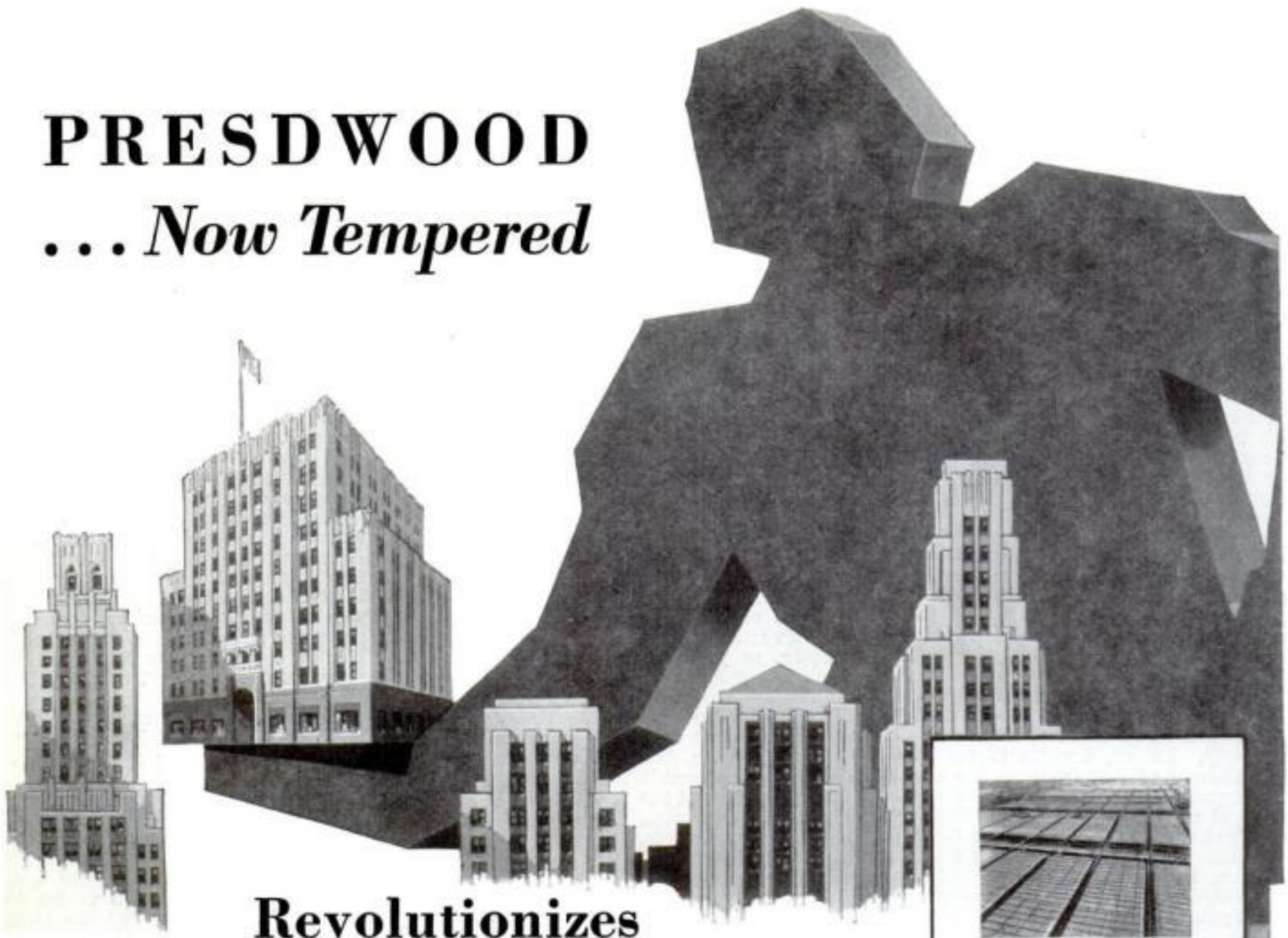
The principal object of the rotor-foil is to reduce the drift factor and increase the lift factor of the lift-drift ratio of airfoils. The drawings, figures one, two, and three, are comparative drawings of the Flettner rotary airfoil, the rotor-foil, and the standard aeroplane airfoil in like working positions. The rotor is the leading edge of the rotor-foil and an ordinary aeroplane equipped with rotor-foil wings would have a twelve to eighteen inch leading edge, and the giant Dornier DOX flying boat would use a wing with a ten-foot leading edge. The angle of incidence at which the plane would fly would be less and the lift force would be two or three times as great as in present planes. The idea is simplicity itself, but it may revolutionize aviation. Who knows?—B. W. K., San Diego, Calif.

Broadminded, but on the Warpath

IN A recent issue of POPULAR SCIENCE MONTHLY W. H. B., Boston, Mass., had the nerve to say he didn't like carpentry. I would like to tell him that the editor of this magazine is trying the best he knows how to please his readers, and just because the name science is on the cover is no reason why you should kick. We don't care whether you like carpentry or not, there are plenty that do, and if the editor had less carpentry his magazine wouldn't have the sale it does today. There are bound to be articles that do not interest every one, but a little praise will go a lot farther than kicking about what you read. Think it over, W. H. B.

I certainly am in with D. W., of Mott, N. D., when he says if you cut out anything in your magazine it will lose its attraction for many readers. He also recommends aviation. So do I, because it is one of our greatest growing industries. Go to it, Editor. Print anything you believe will interest your readers. You have the *best* all around magazine of its kind on the market, and I'm thinking it is the best education we can get for the money.—C. A. H., Los Angeles, Calif.

PRESDWOOD
...*Now Tempered*



Revolutionizes concrete construction methods

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A new Presdwood . . . subjected to treatment that does for these grainless wood boards what tempering does for steel. Marvelously increased in density, strength, and imperviousness to moisture.

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Many of the country's foremost builders and contractors are using Tempered Presdwood . . . and finding that it sets a new standard for economy and speed in construction. And, furthermore, that it wipes out hitherto-accepted limitations in design and application. Write for the complete story of this new Presdwood achievement. Mail coupon today.

The St. Louis University's School of Commerce & Finance. Gillespie & Daley, contractors, used 60,000 sq. ft. ¼" Presdwood as concrete forms for 150,000 sq. ft. area, producing smooth surface concrete of notable strength. The 3' x 12' pans permitted saving in concrete due to their size

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Note the smooth surface of the concrete—no grinding, extra finishing or plastering required. After being stripped, the Presdwood used was removed and made into forms for other concrete construction

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POPULAR SCIENCE MONTHLY

RAYMOND J. BROWN
Editor

August, 1931 Vol. 119 No. 2

NOW—

Real Detectives Beat Sherlock Holmes

By EDWIN W. TEALE

● THIS *Is the First of a Series of Articles on the New Use of Science in Trailing Crooks . . . This Work, As Now Carried on, Makes the Most Thrilling Series of Detective Stories Ever Published . . . In Future Issues Each Branch of Science Used by the Police Will Be Taken Up Separately with Instances of Its Aid in Capturing Criminals*

A NEW type of detective is stepping from the pages of fiction to fight the modern criminal.

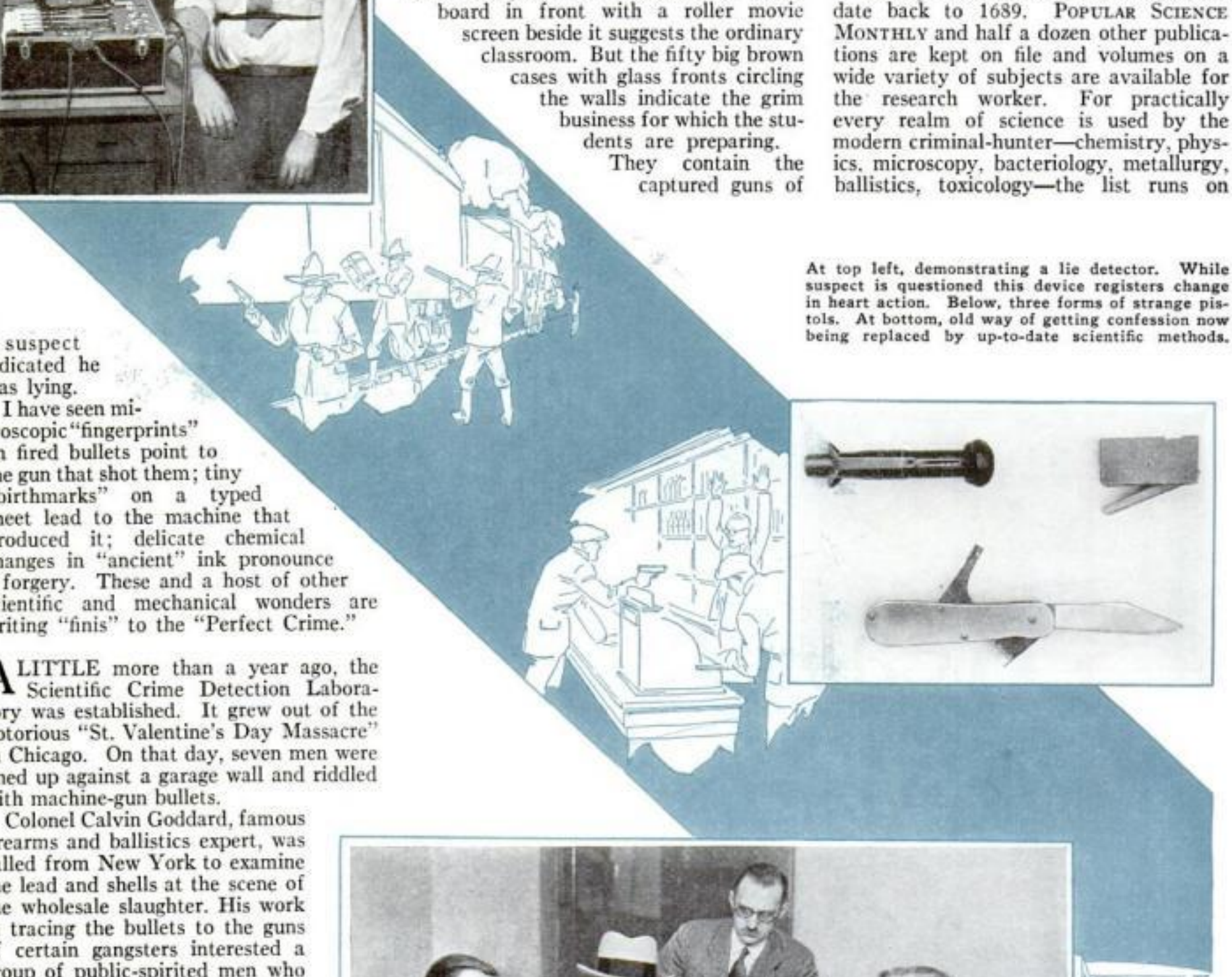
He is hunting the big game of the underworld with strange new weapons; following a trail of hidden clues with delicate machines that almost think; using, as the tools of his trade, the thousand and one recent discoveries of science.

Since the days of Poe and Conan Doyle, readers have followed the breathless exploits of Sherlock Holmes and his fellow man-hunters as they trailed their quarry with test tube and microscope—between the covers of books. Many people still think of scientific crime detection as confined to literature. Few are aware that a random page from the casebook of a score of 1931 detectives would reveal just as thrilling, and even more amazing, stories of applied science wrecking the plans of the underworld.

No carefully-planned plot by a master story-teller could be more dramatic, or more astonishing in its solution, than scores of real-life detective mysteries I have just heard, often from the lips of those who solved them. I have been going to school at the only "college" of its kind in America, the recently-established Scientific Crime Detection Laboratory in Chicago. Here, more than thirty picked candidates are being trained. They are no correspondence school amateurs. They are seasoned veterans from the homicide squads of a dozen cities.

DAY after day, I have seen them working with new marvels, strange drugs, super-sensitive machines, the latest application of laboratory research in the fight to conquer the criminal.

I have seen queer, invisible rays of "black light" pick out a counterfeit bill from among a hundred good ones. I have seen infinitesimal specks of dust expand under great compound microscopes into damning evidence. I have seen the thin needle on a delicate dial swing like an accusing finger when tiny changes of electrical current in the skin pores of



At top left, demonstrating a lie detector. While suspect is questioned this device registers change in heart action. Below, three forms of strange pistols. At bottom, old way of getting confession now being replaced by up-to-date scientific methods.

a suspect indicated he was lying.

I have seen microscopic "fingerprints" on fired bullets point to the gun that shot them; tiny "birthmarks" on a typed sheet lead to the machine that produced it; delicate chemical changes in "ancient" ink pronounce a forgery. These and a host of other scientific and mechanical wonders are writing "finis" to the "Perfect Crime."

A LITTLE more than a year ago, the Scientific Crime Detection Laboratory was established. It grew out of the notorious "St. Valentine's Day Massacre" in Chicago. On that day, seven men were lined up against a garage wall and riddled with machine-gun bullets.

Colonel Calvin Goddard, famous firearms and ballistics expert, was called from New York to examine the lead and shells at the scene of the wholesale slaughter. His work in tracing the bullets to the guns of certain gangsters interested a group of public-spirited men who saw the need of a scientific crime detection school and laboratory and offered to provide the financial backing necessary. As director, Colonel Goddard gathered about him a corps of experts, and the laboratory opened last April on the fifth floor of a loft building near Lake Shore Drive.

It is the latest link in a world-wide chain of scientific crime detection centers. Recently, to aid the police of different countries, a world clearing house for information about international crooks was established in Vienna, Austria. Another innovation is being tried in Germany. At Berlin and Dresden, handwriting specimens of known criminals are filed away with their fingerprints. One conviction a week has been the record of this bureau during the past year. Other scientific crime laboratories are operating in Paris and Lyon, France; Madrid, Spain; and Lausanne, Switzerland. The Chicago organization is the first of its kind to be established in America.

AS you enter this fascinating workplace of scientific sleuths, you find yourself in a labyrinth of connecting rooms and corridors. At the center, ringed by chemical laboratories, photographic studios, and experimental rooms of half a dozen varieties, is the demonstration and lecture hall. Here, rows of chairs and a blackboard in front with a roller movie screen beside it suggests the ordinary classroom. But the fifty big brown cases with glass fronts circling the walls indicate the grim business for which the students are preparing.

They contain the captured guns of noted gangsters; collections of fingerprints and tire treads; examples of writing and typing that have figured in mysterious crimes. One is nicknamed the "pineapple crate." It holds burned fuses, bits of shattered bombs, remains of deadly infernal machines. Another exhibits clothing worn by murder victims, covered with blood-stains now brown, as though made by varnish. Each object in this strange museum has behind it a nerve-tingling tale of crime and violence. Every case contains a dozen front-page stories.

JUST outside the lecture room is the library. Its books on crime detection date back to 1689. POPULAR SCIENCE MONTHLY and half a dozen other publications are kept on file and volumes on a wide variety of subjects are available for the research worker. For practically every realm of science is used by the modern criminal-hunter—chemistry, physics, microscopy, bacteriology, metallurgy, ballistics, toxicology—the list runs on

True Mysteries *of* Crime...

indefinitely. Often subjects that seem far-removed from crime come to the aid of the baffled officer.

Take entomology, the study of insects and their habits. That apparently offers little in solving a murder mystery. Yet, in half a dozen cases it played the deciding role. In one, it placed the finger of justice upon the guilty person, who thought himself safe, weeks after the crime was committed.

THIS was the famous "Home Brew Murder Case," which, some years ago, attracted world-wide attention because a microscopic, blind beetle finally led officers of the law to the house of the slayer!

The body of the victim was discovered hidden among the weeds in a vacant lot. It was evident that he had been dead for some time, and there appeared to be no clues to his slayer. Carefully placing the clothes of the murdered man in a paper bag, the scientific detective in charge beat them with willow wands until all the dust they contained was at the bottom of the container.

Examining this carefully with a high-powered microscope, he found two interesting things. One was a number of specimens of a tiny sightless beetle found only in dark cellars. The other was a quantity of yeast spores of the type used in making beer. This indicated that the body had been kept for some time in a dark cellar in which beer was being brewed.

After listing all persons who had possible motives for the killing, the detective examined their cellars. In scraping the walls in one basement, he discovered large numbers of the blind beetles. In a dark corner, not far from the home brewing outfit, he also detected a dark stain. Analyzed in the laboratory it proved to be blood. When confronted with this evidence, the suspect confessed and the mystery was solved.

At upper right, Calvin Goddard, Director of Scientific Crime Detection Laboratory, fires pistol to get bullet. Below, tape that helped solve murder mystery. At bottom, Ferdinand Watzek, of Vienna, with a mask of the material "moulage."

In examining stains to determine if they were made by human blood an entirely new method has been evolved. Carnegie Institution scientists, in Washington, D. C., discovered that the crystals of hemoglobin, the material forming the red corpuscles, have a peculiar shape in the human life stream by which they can be recognized.

ANOTHER method of analysis carried on in the chemical laboratory has been perfected by Dr. L. Hektoen, of the McCormick Institute, Chicago. By it, he can detect human blood in solutions having only one part hemoglobin to 50,000 parts water. In one case, he was able to take tiny shavings from a floor that had been carefully scrubbed after a crime and determine the presence of human blood!

In a score of other ways the chemical laboratory comes to the aid of the scientific detective in his fight on the modern criminal. In a New York robbery, a year or so ago, entry was made into a building by filing through a lock. A suspect was picked up by the police. His alibi seemed sound until experts examined the dust in one of his trouser cuffs. It contained several glittering particles like gold. An analysis in the chemical laboratory showed these specks of metal to be composed of the identical alloy used in the lock that had been filed.

Dust and (Continued on page 112)

Stranger *than* Fiction

DO SHARKS *Really* BITE?

This unusual photo shows the saw-edged teeth with which the shark tears its victim's flesh.

Is It Possible to Learn the Truth About the Habits of Alleged Man-Eaters in the Semitropic Water? Here Is the Report of a Study Made for Popular Science Monthly by One Who Now Fears the Swift Monsters

By JOHN CHAPMAN HILDER

It required months of effort to get this photo of the razor-sharp fangs of the barracuda.

SOME years ago, I heard a celebrated naturalist state unequivocally that sharks would not attack men. As proof of his statement, he cited his own experience in shark-infested waters. Clad only in a bathing suit and a diving helmet, he had descended to the sea bottom, staying there for considerable periods while sharks and other fish swam negligently about, merely evincing a mild curiosity in his presence.

Further, this naturalist said that, though he had tried in various parts of the world to run down instances in which men had been attacked by sharks, he had failed to discover a single authenticated case. He gave it as his opinion that attacks hitherto attributed to sharks had in reality been perpetrated by that other killer of the sea, the barracuda.

Not being a naturalist, I do not propose to set up my own opinions in controversion of an expert. Nevertheless, I have gleaned a few items of information that do not gee with the theory that the shark is as harmless as a dove.

Not long ago, several young men were swimming in an inlet on the east coast of Florida, diving into the water from a bridge. Suddenly, at the cry of "shark," they scrambled to land. From the bridge, the intruder, a good sized fish, was plainly visible. It had cruised in from the ocean, as sharks often do, in search of food.

Among the swimmers was one who was not afraid of sharks. "They don't attack men," he declared. To prove his theory, he waited until the fish floated close to the bridge and then jumped onto its back.

The shark promptly amputated the rash young man's arm at the shoulder. And had not his companions succeeded in driving the brute off, there would have been nothing left of him. At any rate that is the way the story was, authoritatively, told to me.

THIS incident, of course, proves nothing except that if you jump on a shark's back it will resent the familiarity. Suppose we take another case, one in which, according to the best report I could get, a shark struck without such open provocation.

On the Inlet at Palm Beach, five minutes' walk from where I live, is a municipal dock. Last summer, the dockmaster went down to the ocean to take a dip before breakfast. He had waded out and was standing still in waist-high water, when something suddenly seized his foot.

Shouting for help, he got out of the water as fast as he could—with most of his heel ripped off. He did not see what had bitten him, but the doctor who treated his wound, and several professional fishermen who examined it, say that beyond question only a shark could have inflicted the injury.

A man who lives in West Palm Beach is minus part of his hand. Going bathing in the ocean, he ran exuberantly into the surf and dove headlong through a roller. Instantly one of his hands, he says, was seized by a small shark. He beat at it with the other hand and managed to get free.

THERE is a negro living in West Palm Beach whose scalp, he insists, bears the marks of a shark's teeth. He is a native of the Bahamas, where his memorable adventure occurred when he was a boy. He was seized following a dive and rescued by companions just in time.

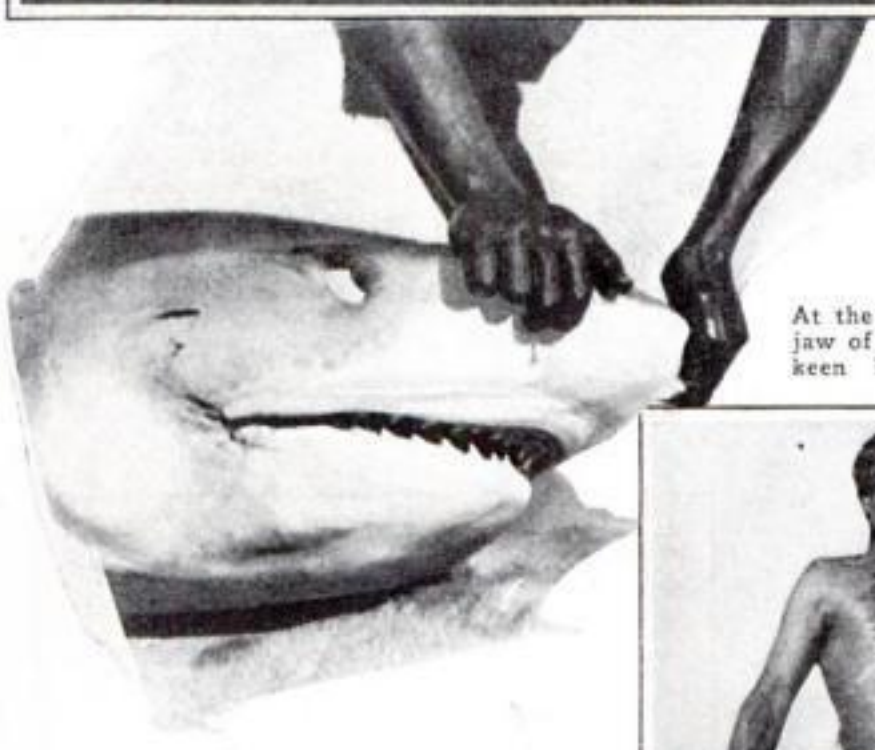
The fact that tropic and subtropic waters contain dangerous fish does not mean that it is impossible to swim in them without being attacked. It does mean, however, if these stories are true, that there is an ever present risk of attack. Some persons, confident that they have charmed lives, go for long swims off the Florida coast, firmly believing that the fish that is to attack them has not as yet been spawned.

There was one such enthusiast who used daily to swim about a mile out from shore. Having done this for some time without

Spotted like the leopard, the moray eel, a powerful brute sometimes six feet long, lies in wait for its prey hidden by rocks. A big one can bite off a man's hand or foot and is always dangerous.

Photo made by J. F. Williamson, pioneer undersea photographer, who has been studying sharks. It shows a native with a knife in his teeth on trail of man-eater.

At the left, note the short lower jaw of the shark, armed with its keen backward slanting teeth.

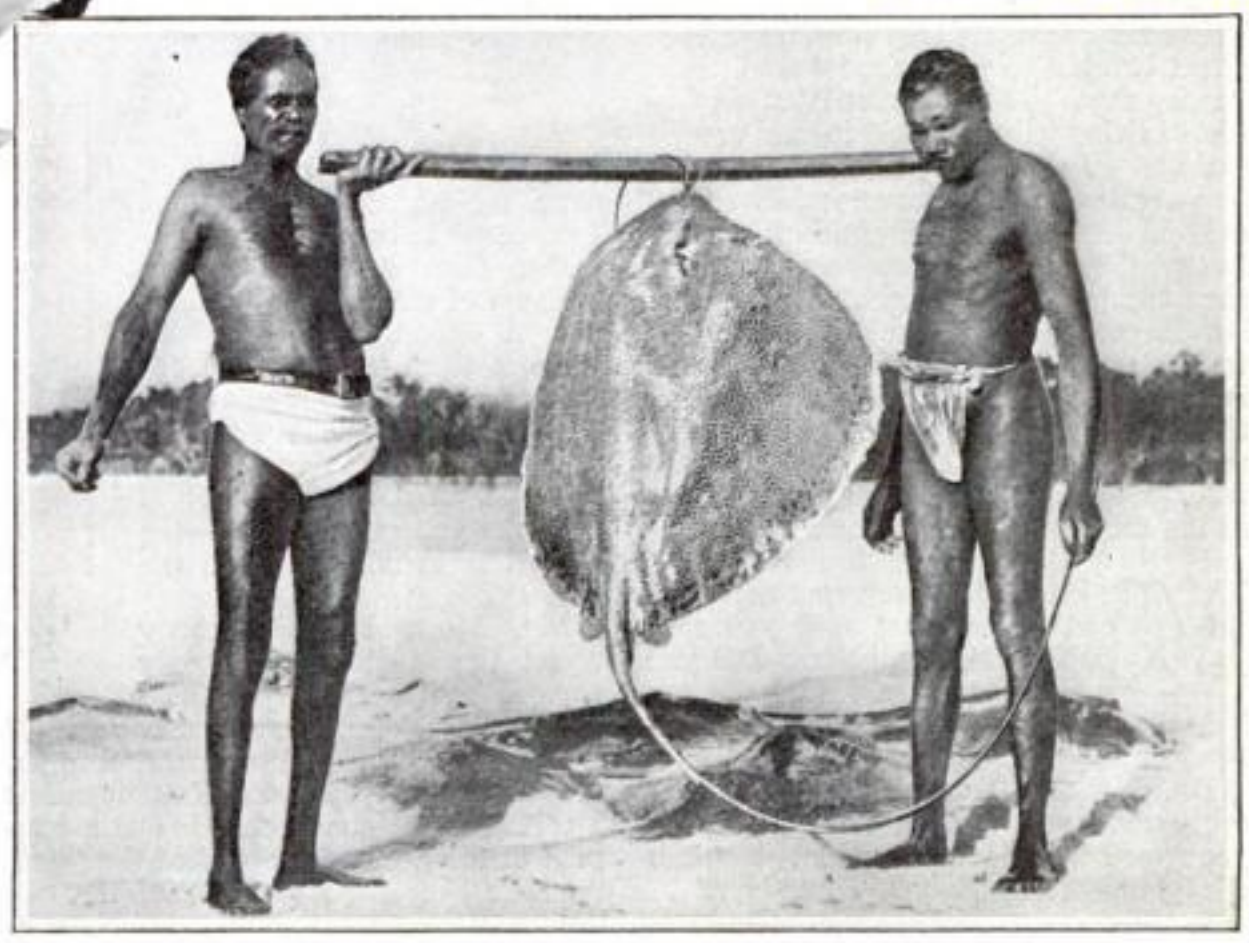


mishap, he pooh-poohed the suggestion that it was a hazardous pastime. One day, he felt something take a piece out of his thigh.

Swimming frantically, he made for the beach, conscious of subsequent bites en route. In the surf, he fainted from loss of blood, but was pulled to land. Those who rescued him insist that he encountered a school of small sharks, that literally fed on him as he swam. At the hospital, to which he was rushed, they despaired of saving his life; but after a year's confinement, he recovered.

I know of another enthusiast, a close friend of many friends of mine, who also paid the price of his foolhardiness. Though warned that a shark had been seen lurking in the vicinity of the spot where he proposed to swim, he disregarded the warning. A few minutes later, he too was carried, in a fainting condition, out of the surf, with the greater part of one calf torn away, presumably by the shark.

Out in California, I have four times felt earth tremors. There was no mistaking them for *(Continued on page 114)*

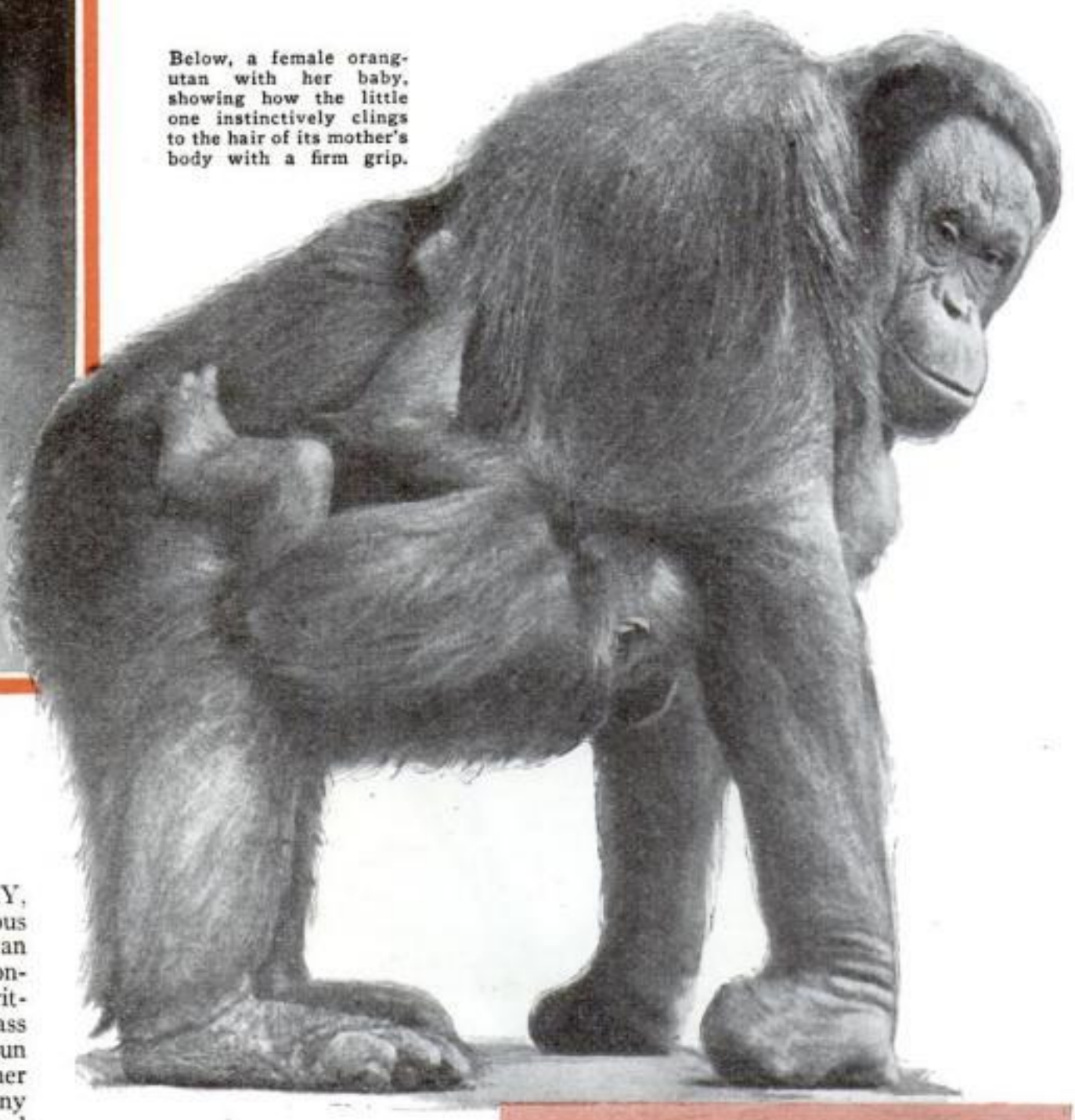


Barracudas and sharks are not the only dangerous denizens of the Southern Seas. This sting ray, armed with a barbed, boney lance near the root of its tail, can inflict a poisonous wound.

Why Some Babies

Others are covered with hair can hang by their hands like

A baby less than one month old can support its weight hanging by its hands.



Below, a female orang-utan with her baby, showing how the little one instinctively clings to the hair of its mother's body with a firm grip.

What Dr. Gregory Has Told:

WILLIAM K. GREGORY, internationally famous scientist of the American Museum of Natural History, in conversation with Michel Mok, staff writer, has explained that the earth, a mass of hot solar gas, was torn from the sun about two billion years ago by another passing star. A billion years later, tiny bits of living jelly appeared in mud and puddles. Later they crowded together into small wormlike creatures which slowly evolved into air-breathing fishes. When finally they crawled out onto the land they became our ancestors. Last month, Dr. Gregory told how man's face, inherited from a shark, is, first, a trap to catch food and, then, an instrument board containing the receiving parts of range-finding instruments such as eyes, ears, and nose. This face, said Dr. Gregory, is only one feature in the museum known as man.

MR. MOK: Dr. Gregory, toward the end of our last talk you said that man is a museum. Did you mean that some old people are living reminders of the fashions and customs of a bygone day?

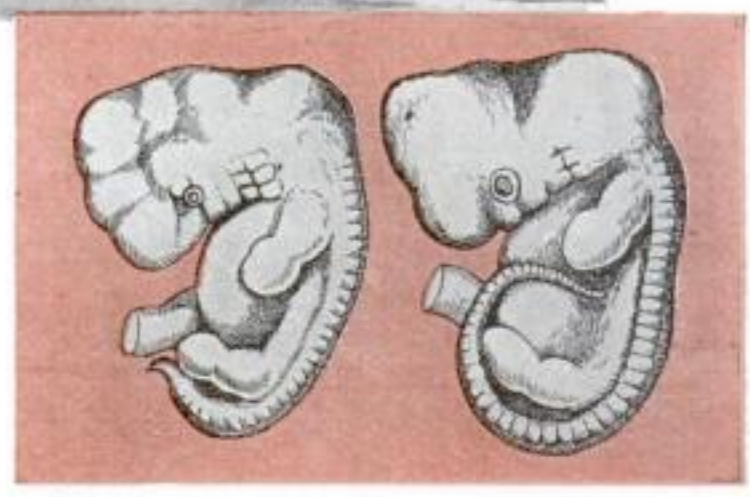
DR. GREGORY: Not at all. I meant that every man and woman, no matter how young or how old, is a museum. You are one yourself, though you don't know it.

MR. MOK: This is surprising news. What kind of museum am I supposed to be?

DR. GREGORY: You are a museum of antiques and curiosities; a collection of remnants, some of them nearly half a billion years old. The reason tourists from far and near don't come to see you is that there are some 1,906,000,000 museums just like you in the world—the other human inhabitants of the earth.

MR. MOK: I don't exactly regret that I am not the only one. What are some of these antiques and curiosities I carry around?

DR. GREGORY: The little red spot in the corner of your eye is one. You remember I told you last month that it was a remnant of the horizontal eyelid of the shark. Another one is the remnant of the tail.



Left, above, a human embryo as it appears when about eight weeks old, in which a tail is evident. At the right is shown an embryo of a monkey.

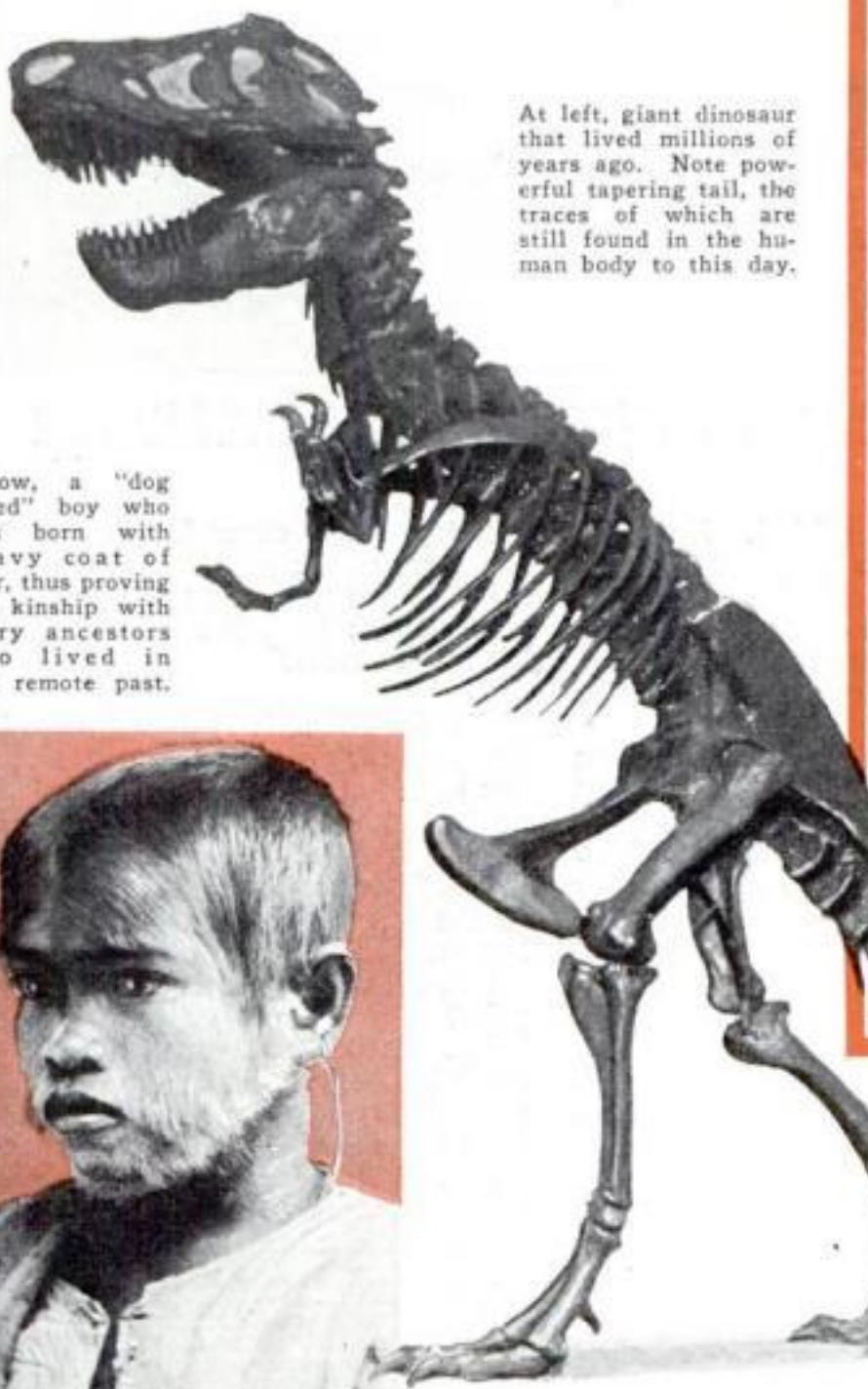
MR. MOK: But we have no tail remnant!

DR. GREGORY: Oh, yes, we have. You have the remains of a tail, and also of the muscles and nerves for wagging it. I will tell you all about it in a minute. But first

DR. W. K. GREGORY Continues His Thrilling Story

are Born *with* Tails...

and all young infants monkeys in the trees



At left, giant dinosaur that lived millions of years ago. Note powerful tapering tail, the traces of which are still found in the human body to this day.

This gibbon, which has specialized in arms and the power to throw itself from limb to limb in the forest, is one of the apes that has many features similar to those now to be found in the bodies of human beings.

Below, a "dog faced" boy who was born with heavy coat of hair, thus proving his kinship with hairy ancestors who lived in the remote past.

let me ask you something. Do you know what a tail really is?

Mr. Mok: I should call it the part of an animal's backbone that protrudes behind its rear legs.

Dr. Gregory: It is much more than just a continuation of the backbone. It is that part of the rear end of the animal, all complete with muscles, tendons, nerves, skin, and hair, that begins at the end of the body cavity containing the digestive and other vital organs. You must not think of it as something separate. There is nothing separate or strange about it. The strange thing is that man does *not* have a tail.

Mr. Mok: We seem to get along all right without it. What is the tail for?

Dr. Gregory: To many creatures, it is almost as important as the face. In the fishes, for example, it is a vital part of the navigation machinery. The earliest land animals still used it to move about with; that is, they used the powerful muscles on either side of the tail for pulling the hind legs alternately backward in crawling. And some reptiles, including the alligator, use it as a terrible weapon—a flail.

Mr. Mok: Does it play an important part in any of the animals we know best, such as the dog, the cat, the horse, and the cow?

Dr. Gregory: No, in the mammals it is an almost useless appendage. The dog uses it merely for wagging; in other words, to express its emotions. So does the cat. Horses, cows, and other mammals use it as a fly switch. The reptiles had thick, massive tapering tails, almost as big as the rest of their bodies. That was a remnant of the old streamline design of the fishes. The mammals took a big step toward the human condition. As their hind legs came closer together, their tails narrowed behind the legs.

Mr. Mok: How did it finally disappear?

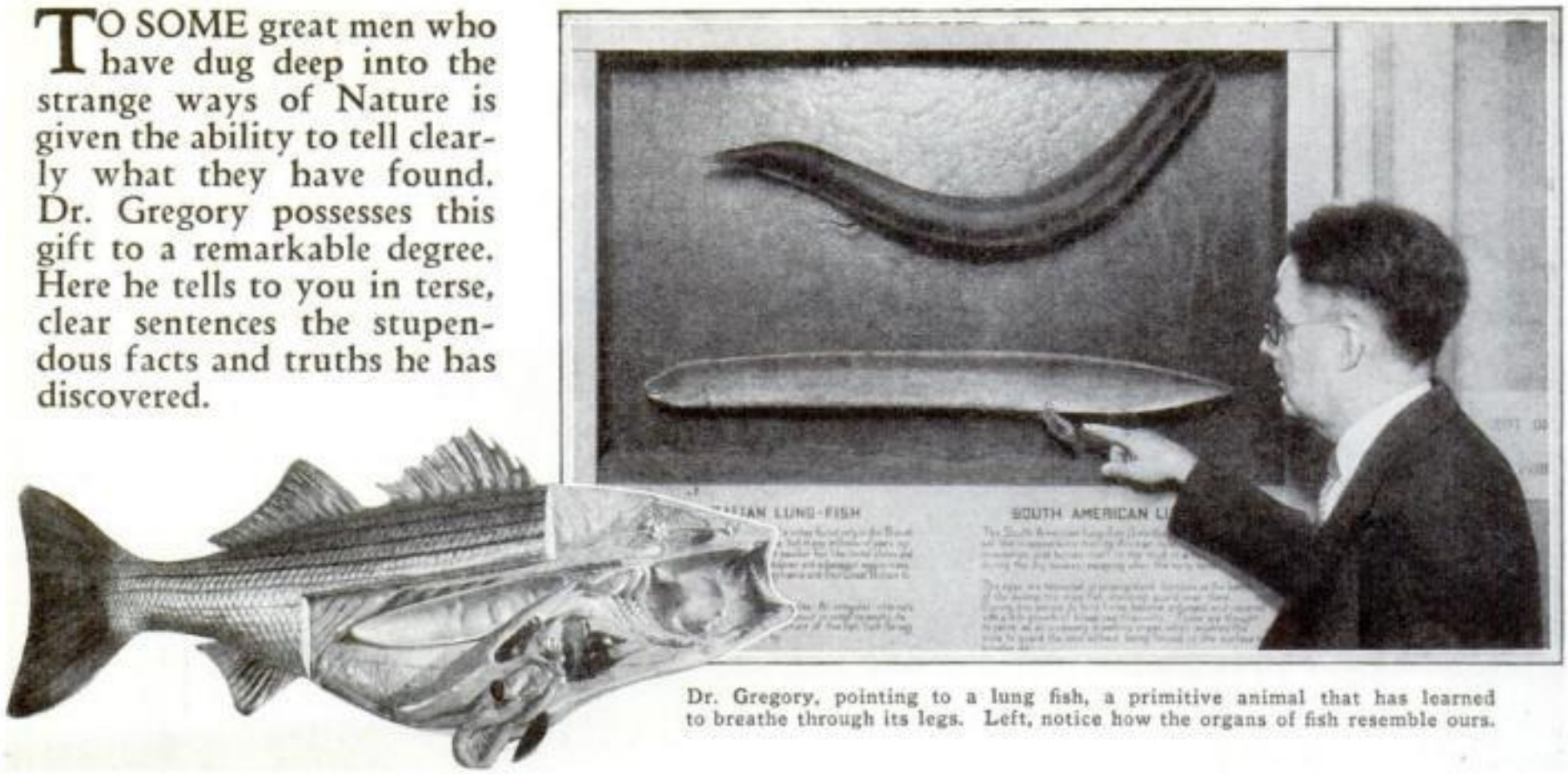
Dr. Gregory: It never disappeared entirely, as you will see in a moment. Certain monkeys used their tails to hang on to the tree branches. Some South American monkeys use it as a fifth hand, but the Old World monkeys, to which we are related, don't use their tails that way. In them it is almost useless. You can see the successive stages in the reduction of the tail in some of the Old World monkey types, such as the macaques and baboons. It finally dwindled down to a tiny, curly "pigtail."

Mr. Mok: The great manlike apes have no tail, have they?

Dr. Gregory: Outwardly, they have not. So, you see, the tail was lost before man appeared. Some people believe that

of "LIFE... THE WORLD'S GREATEST MYSTERY"

TO SOME great men who have dug deep into the strange ways of Nature is given the ability to tell clearly what they have found. Dr. Gregory possesses this gift to a remarkable degree. Here he tells to you in terse, clear sentences the stupendous facts and truths he has discovered.



Dr. Gregory, pointing to a lung fish, a primitive animal that has learned to breathe through its legs. Left, notice how the organs of fish resemble ours.

the lack of a tail is an important distinguishing characteristic of man. That is wrong. Several kinds of apes and monkeys lost their tails long before there was any sign of man on earth, but that loss did not by any means make them men.

MR. MOK: What did you mean when you said it never disappeared entirely?

DR. GREGORY: The manlike apes still have a row of little bones, buried deep in the flesh, that plainly corresponds to the front end of the tail of the lower monkeys. They also have the muscles and nerves that once were used for wagging the tail. In other words, they have a tail remnant.

MR. MOK: And how about us?

DR. GREGORY: Now I am coming to you. At the base of your spine, buried deep in your muscles, there is that same row of little bones, and the muscles and nerves that go with them. A remarkable fact has been discovered by Dr. Adolph H. Schultz, of Johns Hopkins University, an eminent investigator of such matters. He found that there are manlike apes with *less* tail remnant than man has.

MR. MOK: Is there any other evidence of our "tail-bearing" ancestry?

DR. GREGORY: Yes, and scientists consider it most convincing. Every man before he was born had an unmistakable prolongation of the backbone which is obviously nothing but the remnant of the ancient tail. It occurs from the fourth to the eighth week in the unborn baby's development. Sometimes it does not disappear.

MR. MOK: You mean that some babies are born with tails? I have heard of it, but I did not know it actually happened.

DR. GREGORY: It does. There are two classes of such human tails—false tails and true tails. The false outnumber the true. Many reported cases of babies born with tails are in the nature of tumors. But when all these are accounted for, there still is a considerable number of babies born with real tails. The latest and most authentic report is that of Dr. Schultz, who has made a special study of the subject. He found that there are close to 150 cases on record of babies born with genuine tails. The most striking case he discovered was that of a boy born with a tail nine inches long.

MR. MOK: What causes a baby to be born with a tail?

DR. GREGORY: It is probably due to a disturbance, or arrest, in the development of the unborn baby about the eighth week, when the tail usually shrinks away. Why this happens is difficult to say. Possibly it occurs for the same reason that some babies are born idiots; only this happens at the other end of the body.

MR. MOK: What are some of the other "exhibits" in my museum?

DR. GREGORY: The great German anatomist, Wiedersheim, has recorded 180 vestiges in the human anatomy; that is to say, remains of organs or other bodily parts that are now entirely or almost useless to us, but that had definite functions in our animal ancestors. One that we talked about last time is the set of muscles for moving the ears. Some people can do it, but the rest of us, who have lost that talent, still have the useless muscles. Naturally, they were very useful to the animals, to which the slightest sound may mean a threat of death. Then, there is your hair.

MR. MOK: Is hair a vestige?

DR. GREGORY: Certainly. Those locks of yours are remnants of the fur coats your animal ancestors wore to retain their body heat. Our hair no longer serves that purpose. Yet, each of the remaining body hairs has a tiny muscle by which it can be raised. In the mammals, the function of these muscles is plain. They use them to bristle their fur in cold weather. This gives them more air in their coats, and they lose less heat as a result, just as a roomy greatcoat keeps you warmer than a tight-fitting one.

MR. MOK: Are these little muscles still active in us?

DR. GREGORY: Yes, but uselessly so. When you are cold, they contract. That is what gives you gooseflesh. The unborn baby, in the later stages of its development, clearly reflects our fur-bearing ancestry. It is covered with a coat of fine, downy hair; sometimes this prenatal hair, like the tail, fails to disappear.

MR. MOK: Does it remain throughout life in such cases?

DR. GREGORY: It does, as you have seen for yourself at the circus, when you looked at Barnum's "dog-faced" boy, or the bearded lady. Another interesting vestige is "Darwin's point," the cone-shaped little projection some people have at the top of the ear, where it folds inward.

MR. MOK: Why is it called Darwin's point?

DR. GREGORY: Because Darwin first showed that it was a remnant of the pointed ears of the mammals. It occurs more often in men than in women.

MR. MOK: That might give women a good argument to show that men are closer to the animals than they are.

DR. GREGORY: Any time a woman gives you that argument, you can counter with the bearded lady! Did you ever take a good look at a newborn baby?

MR. MOK: Yes. Why?

DR. GREGORY: Because then you must have noticed that it is a little acrobat. A child less than one month old can support its weight hanging by the hands; most babies can do it with one hand.

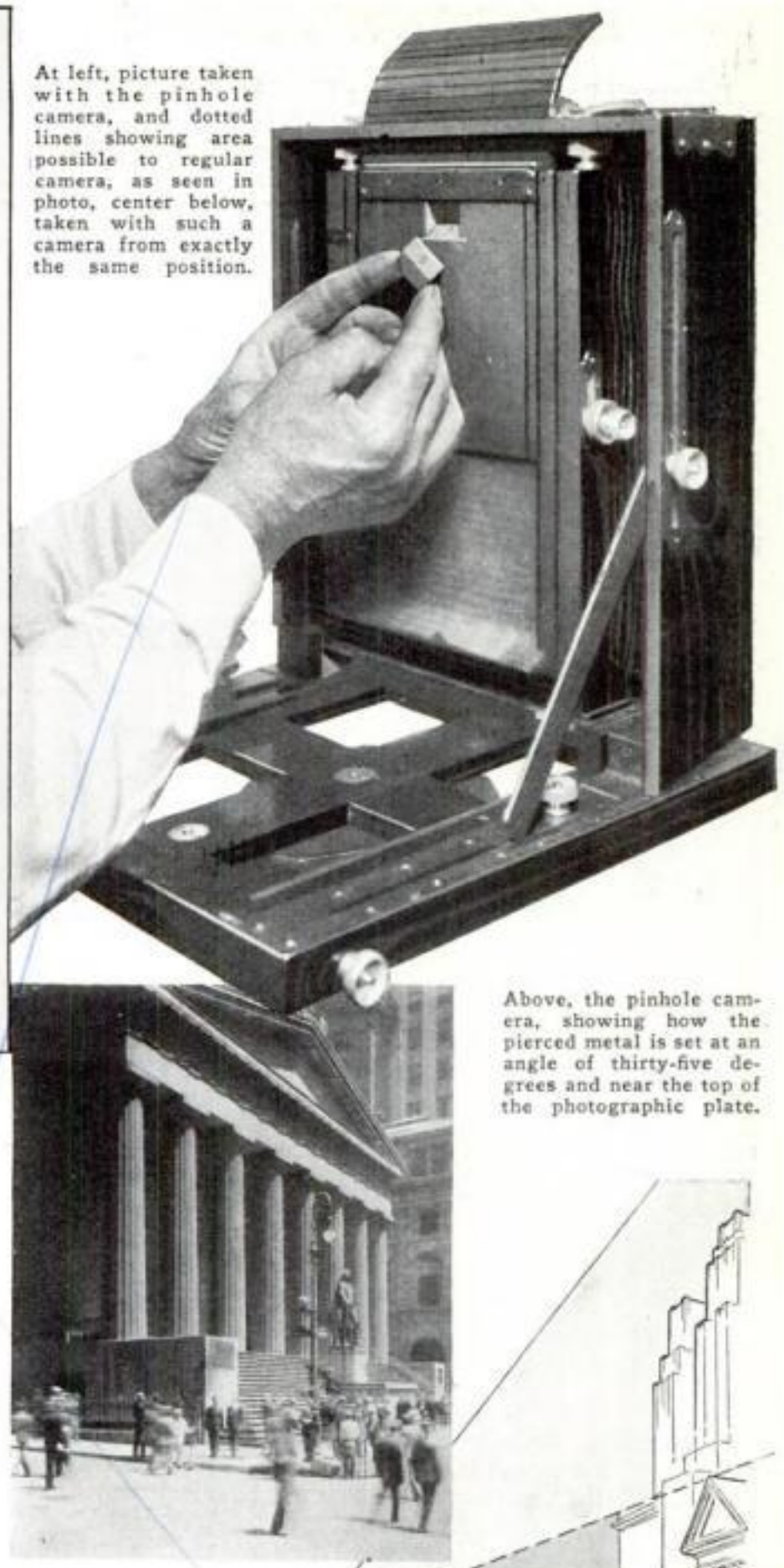
MR. MOK: Perhaps the babies that can do that have inherited the stunt from some ancestor who was an athlete.

DR. GREGORY: So far as I know, all babies can do it, and all have inherited the stunt from ancestors that were acrobats; that is to say, monkeys.

MR. MOK: You mean that they got it from the monkeys' ability to swing by their hands in the branches?

DR. GREGORY: Not exactly. The adults among the monkeys to which we are related have that ability. However, the human baby did not inherit the trick from them, but from the baby monkeys. You see, the mothers among these monkeys travel through the trees carrying their babies. To do so, she has to use her hands, leaving the baby without support. In self-defense, *(Continued on page 117)*

At left, picture taken with the pinhole camera, and dotted lines showing area possible to regular camera, as seen in photo, center below, taken with such a camera from exactly the same position.



Above, the pinhole camera, showing how the pierced metal is set at an angle of thirty-five degrees and near the top of the photographic plate.

Pinhole 'Lens'

Secret of New Photo Miracles

Showing the angle of view possible with an ordinary camera and with the pinhole "lens."

WORKING with a tiny needle and a wafer-thin piece of sheet metal, William A. Wallace, New York photographer, has taken an amazing series of pictures of New York skyscrapers. From street level to topmost floor, he has registered every detail on his film with his camera placed just across the street from these architectural giants. An ordinary camera, similarly placed, would take in only the entrance way and the first two or three floors.

Wallace has arranged a unique variation on the old pinhole camera idea to obtain such remarkable wide-angle pictures. In such a camera the ray of light, reflected from each tiny point in the object photographed, goes through the pinhole in a straight line. These pinpoints of light form an inverted image on the sensitive film.

The pinhole is only thirteen and a half thousandths of an inch in diameter and is cut in shim stock (thin sheet metal) only three thousandths of an inch thick. A number sixteen needle was used to make the hole and then both sides of the metal were rubbed on an oilstone to remove the burr.

Instead of placing the piece of metal containing the tiny hole parallel to the plate, Wallace places it at an angle of thirty-five degrees and about one inch below the upper edge of the plate. The arrangement is shown in the illustration at upper right on this page.

The object of placing the pinhole at an angle and near the top of the plate is to get a more uniform lighting. The lower portion of any tall building is poorly lighted as compared with the top. The lower portion registers on the top of the plate where the pinhole is closer to it and allows more light to get through.

The angular position of the pinhole also helps to make the lighting even. More light goes through a hole at right angles than on a slant.

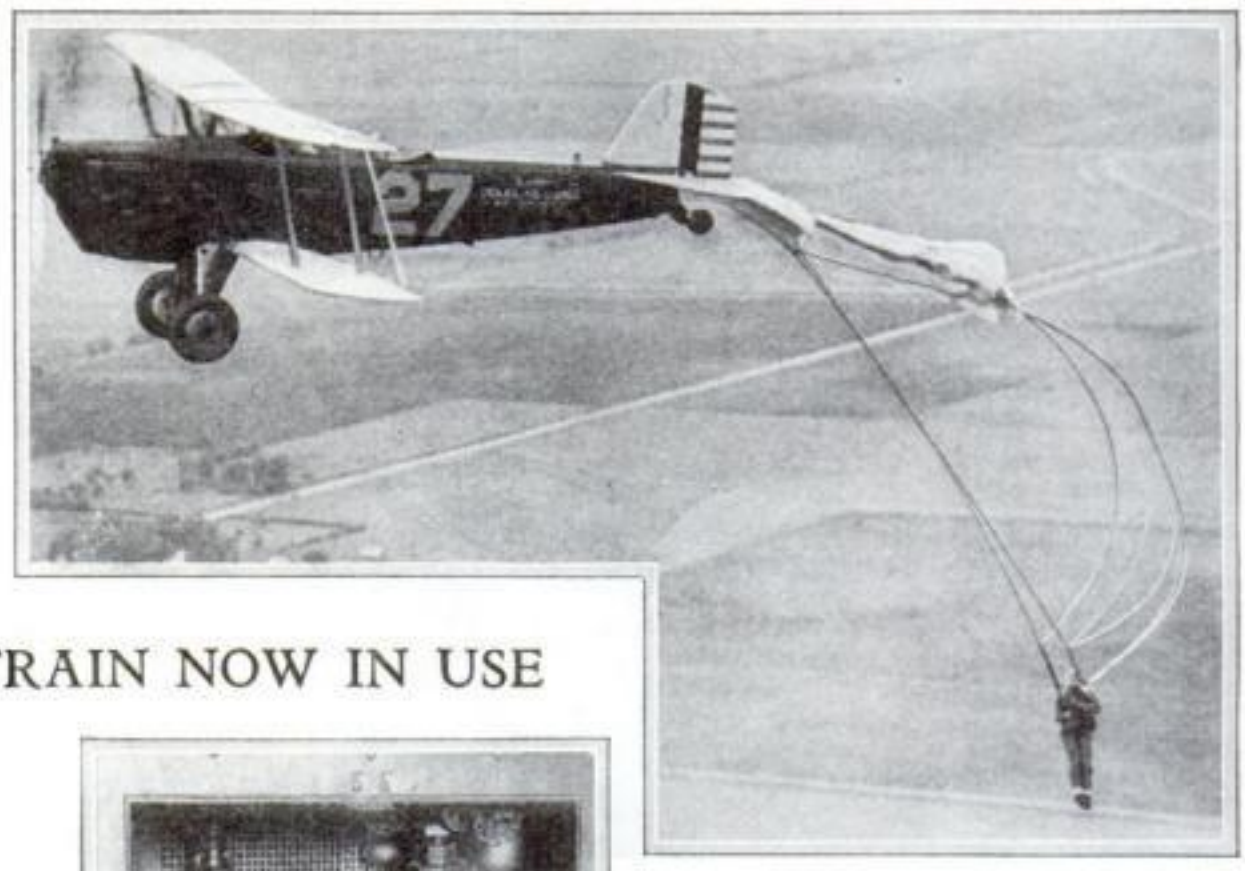
The theoretical angle that could be taken by a carefully prepared pinhole is, Wallace claims, nearly 155 degrees. It is doubtful, however, if this extreme angle of view could ever be attained in practice owing to the reduced amount of light that would strike the edges of the plate.

The views of the towering building, and what appears to be a close-up of the smaller building at its base, were taken without moving the camera. The first exposure was made with the pinhole; the other picture was taken with a lens that included about the same angle of view taken in by the ordinary hand camera.

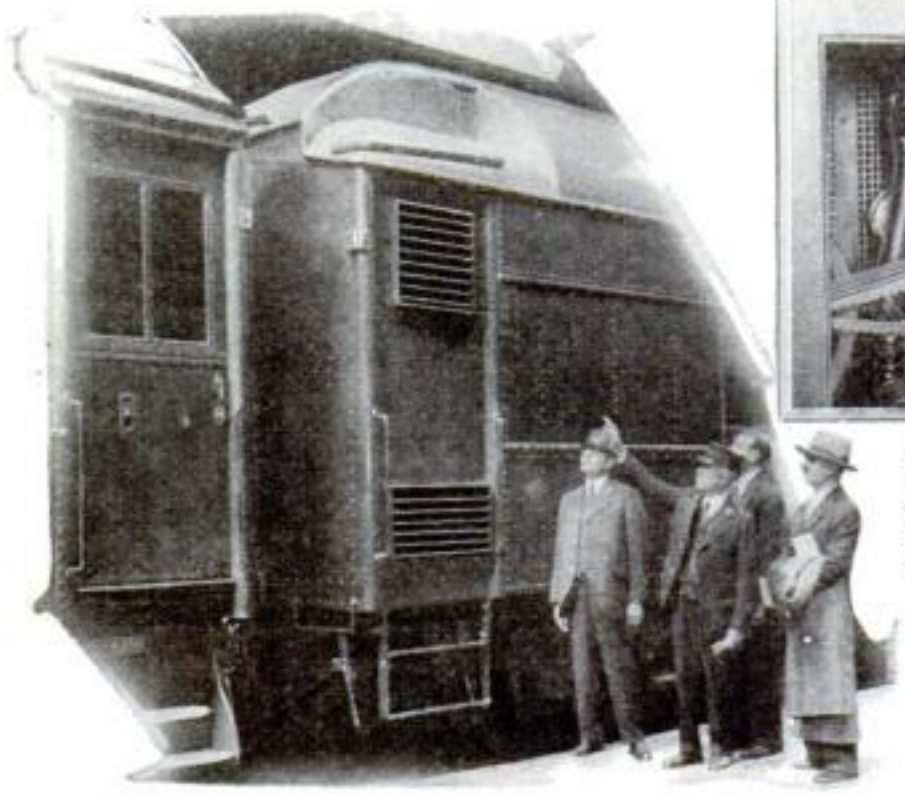
The apparent absence of people in the pinhole view is caused by the long exposure necessary. It was found that the proper exposure with the size pinhole specified, using super-speed film, was one and one half minutes.

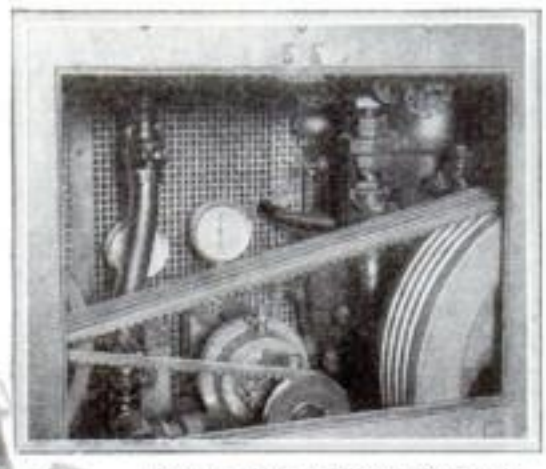
KNIFE SAVES FLYER WHEN PLANE CATCHES 'CHUTE

DEATH all but overtook Private Harold L. Osborne, U. S. Army Air Corps, at Selfridge Field, Mich., the other day, when he attempted a 2,000-foot parachute leap. His opening 'chute caught the tail of the plane. For forty-five minutes Osborne dangled in mid-air behind the speeding craft. Then a rescue plane lowered a knife to him on a string. Osborne cut himself loose and came down safely with an extra parachute he had taken the precaution to strap on his back. This remarkable photo, taken while the rescue ship was maneuvering to pass the knife to Osborne, shows him dangling at the end of the ropes while his 'chute is still entangled. It took ten minutes to get the knife to him after help arrived.



FIRST AIR-COOLED TRAIN NOW IN USE





Above, the refrigerating machine that is located under each car in the air-cooled train. At left, view of ventilating slats in car whose windows are sealed.

ON THE Baltimore and Ohio Railroad the other day an unusual train was put into service. It is the first completely air-cooled passenger train ever used on a regular run. Manufactured weather is supplied to its passengers by devices that suck in air, wash it free of dust by water jets, and cool it by refrigeration before it is passed into the cars. The windows in this unusual train cannot be opened, nor is this necessary, as a constant supply of cool dustless air at the right temperature for comfort is supplied automatically. One vestibule at the end of each of the new cars has no side doors and houses machinery to wash entering air. Single railway cars have been air-conditioned in the past, but this is the first time an entire train has been air-cooled. In addition to the artificial weather apparatus, each car is fitted with rubber shock absorbers.

PNEUMATIC GEAR SHIFT DESIGNED FOR AUTOS

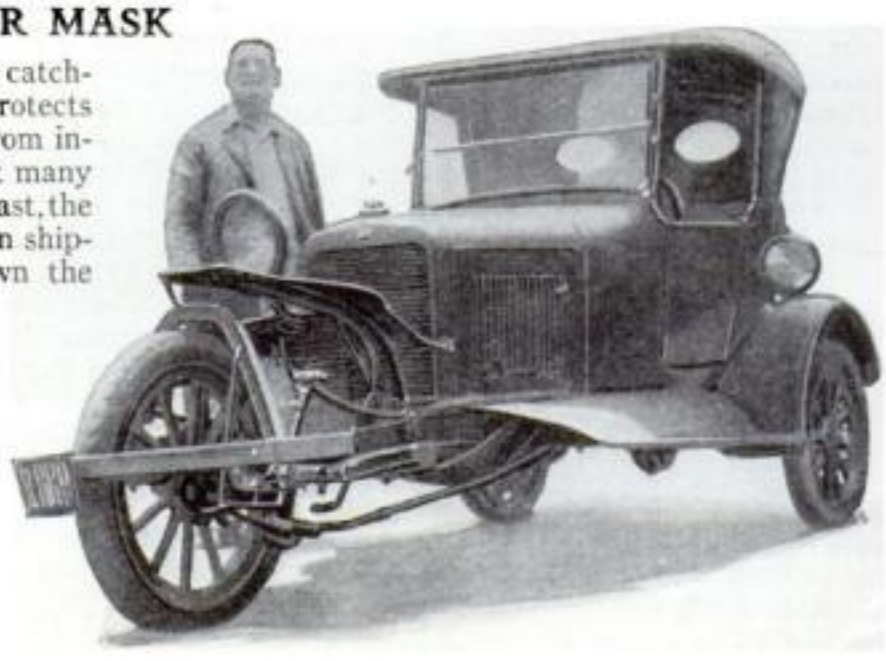
AT THE touch of a handle like an air brake valve, an auto transmission, perfected recently by a Brazilian automobile engineer, works clutch and gear shift by compressed air furnished by a small pump on the engine. The "gears" of this transmission are always in mesh, and make but little noise while being changed. Reversing is accomplished by gears like those of ordinary transmissions.

THREE-WHEELED CAR IS BUILT FROM JUNK PILE

WHEN J. M. Custer, a garage man of Piggott, Ark., set out to build his car, this three-wheeled vehicle was the result. All the material came from the junk pile, and the completed machine cost its builder sixty cents. Several of Custer's own inventions are built into the car. Two lamps on the rear fenders can be used as hand spotlights. The single headlight turns automatically with the front wheel in rounding a corner. Seven different makes of cars furnished parts for the novel vehicle, which probably has no duplicate on American roads.

CLIFF-CLIMBING LIFE-SAVER SHIELDED BY WICKER MASK

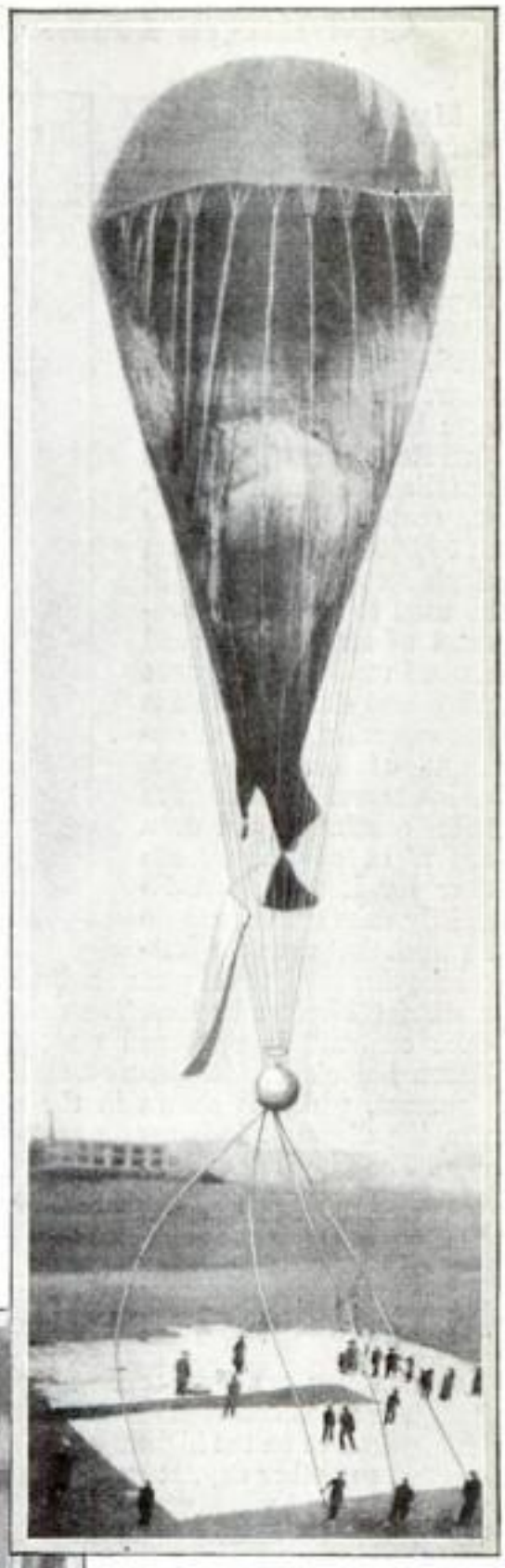
RESEMBLING a baseball catcher's mask a new helmet protects British coast guardsmen from injury when scaling cliffs. At many points along the English coast, the only means of saving life in shipwreck is by climbing down the face of cliffs hundreds of feet high. The heavy wicker mask was devised to protect the guardsman during such descent from abrasive injury by the rough surface of rocks and also from the attacks of birds that make their nests in crevices of the cliff.



Back to earth on Austrian glacier, after soaring ten miles above the earth, priceless scientific records are removed from air-tight aluminum ball.

Ten Miles High
in an AIR-TIGHT BALL

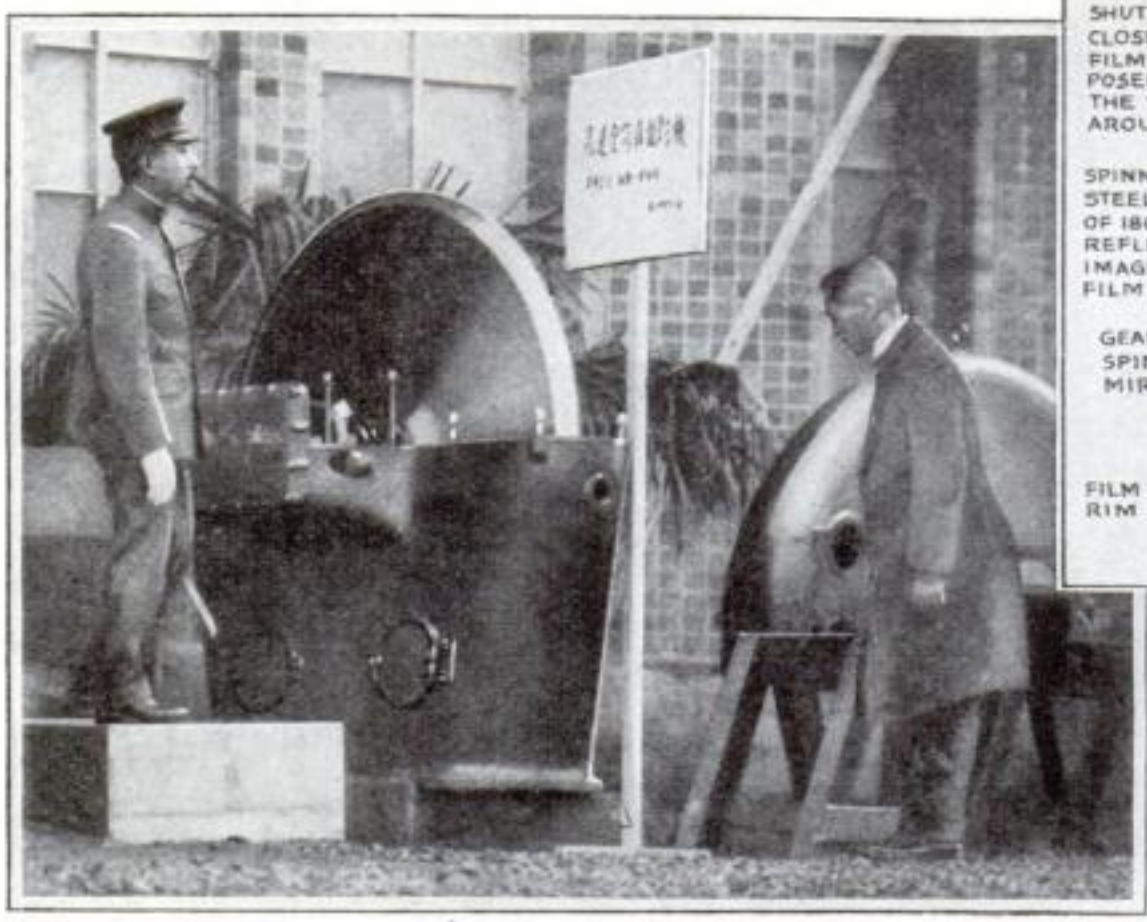
A HUGE yellow balloon soared skyward, a few weeks ago, from Augsberg, Germany. Instead of a basket, it trailed an air-tight black-and-silver aluminum ball. Within Prof. Auguste Piccard, physicist, and Charles Kipfer aimed to explore the air 50,000 feet up. Seventeen hours later, after being given up for dead, they returned safely from an estimated height of more than 52,000 feet, almost ten miles, shattering every aircraft altitude record. Oxygen tanks kept them alive while they made observations. Records of their instruments are now being checked and interpreted. First to rise safely into the upper layer of the earth's atmosphere, they found the air pressure at ten miles altitude so low — one-tenth of that at sea level—that a man exposed to it would perish much as a deep-sea fish bursts of its own internal pressure when brought to the earth's surface. Piccard and his aid found cosmic rays, mysterious radiations from outer space, far more powerful than at the earth's surface, and gaged their intensity. The explorers trapped samples of the upper air, "blue air," as Piccard reported it to appear, in cylinders. Analysis may prove it exceptionally rich in ozone, the intensely blue gas supposedly responsible for the Heaviside layer or "radio roof." The story of their adventure surpasses fiction. During the ascent, the aluminum ball began to leak. They plugged it desperately with vaseline and cotton waste, stopping the leak. In the first half hour the balloon shot upward nine miles. Through portholes, the observers saw the earth through copper-colored, then bluish, haze. It seemed a flat disk with upturned edge. At the ten-mile level the sky appeared a deep, dark blue. With observations complete, the observers tried to descend, but couldn't. While their oxygen tanks emptied, they floated aimlessly over Germany, Austria, and Italy. Cool evening air contracted the balloon's gas and brought them down on a glacier near Ober-Gurgl, Austria, with one hour's supply of oxygen to spare.

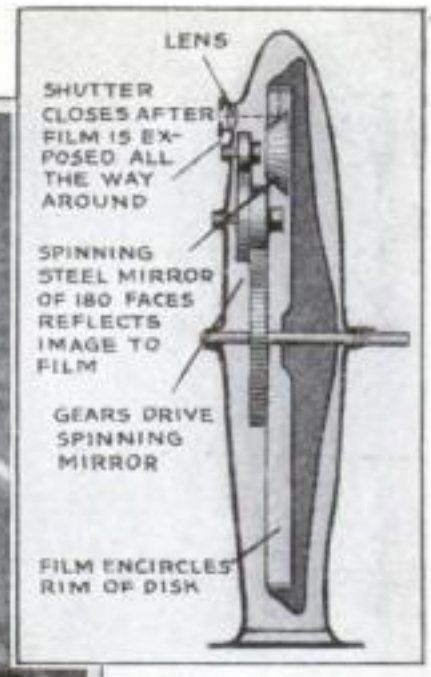


The huge balloon, carrying the big ball in which ride the two scientists, begins its ascent. The metal chamber was designed to save the explorers' lives at altitude never before reached.

Professor Piccard, center, seated within the ball, studies the instruments before the daring ascent. Above, dismantling balloon on the high glacier.

CAMERA TAKES 60,000 PICTURES A SECOND



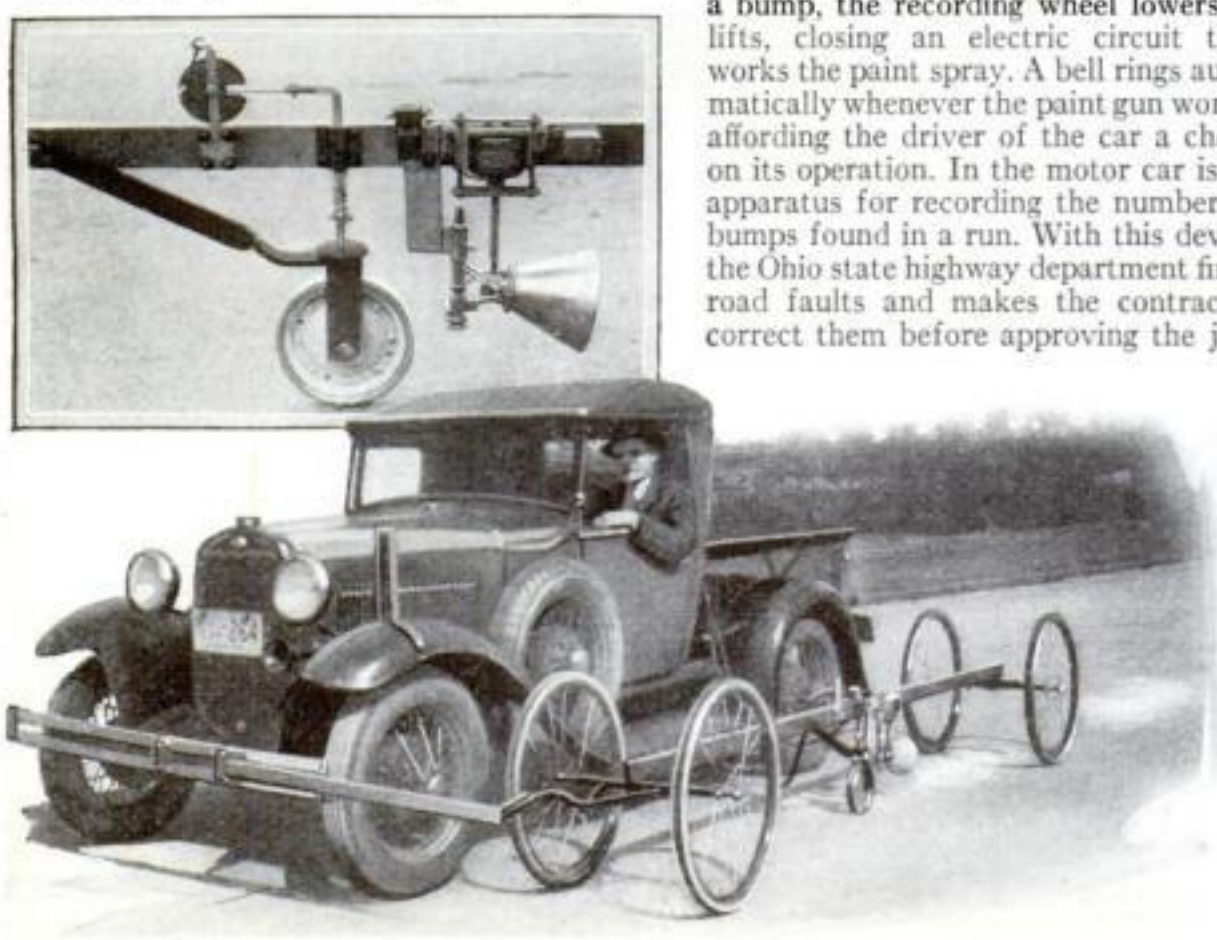


At left, Japanese officials inspecting the new pancake camera which is capable of taking the unprecedented number of sixty thousand pictures a second. Above, diagram of Baron Shiba's camera that takes 40,500 photos a second, until recently the fastest in the world.

MANY believed that the ultimate limit in high-speed photography had been reached when Baron Shiba, Japanese engineer, announced not long ago a camera that could take 40,500 pictures a second (P.S.M., May '31, p. 143). Now, however, the Japanese Institute of Aeronautical Research at Tokyo has installed an amazing camera that can take as many as 60,000 photographs in a single second's time. It will be used to film the movement of air at high speed around models of airplane wings and struts. So fast is this camera that the movement of sound waves, which travel about twelve miles a minute, and even the flight of bullets, are easy for it to record. So swiftly does the camera do its work that even the fastest moving mechanical parts are brought to a standstill before its lens. The new "pancake camera" is patterned closely after Baron Shiba's 40,500-picture-a-second instrument, which is shown in the accompanying diagram. It is nearly as tall as a man. The film is mounted on the inner rim of a huge disk, and spins past a many-sided whirling mirror. As each face of the mirror flashes into line a picture is imprinted on the film. Gears drive the whirling mirror, and an improved system of gears in the new model accounts for its greater speed. When the film on the rim of the spinning disk is completely exposed around its circumference, a shutter automatically closes and prevents a double exposure. The film is then removed and developed.

MACHINE FINDS BUMPS IN NEW ROAD

A STRANGE contrivance that looks for bumps in roads and then marks them made its appearance on the highways of the state of Ohio the other day. It is propelled by a motor car, and whenever it passes over a bump in the road's surface, paint is automatically sprayed on the bump, marking it so repairmen can easily find it and smooth it off. Two pairs of bicycle wheels are connected by a long beam. To the center of this is fixed a recording wheel and the paint gun which is operated by compressed air from a tank in the car. As the device passes over a bump, the recording wheel lowers or lifts, closing an electric circuit that works the paint spray. A bell rings automatically whenever the paint gun works, affording the driver of the car a check on its operation. In the motor car is an apparatus for recording the number of bumps found in a run. With this device the Ohio state highway department finds road faults and makes the contractor correct them before approving the job.

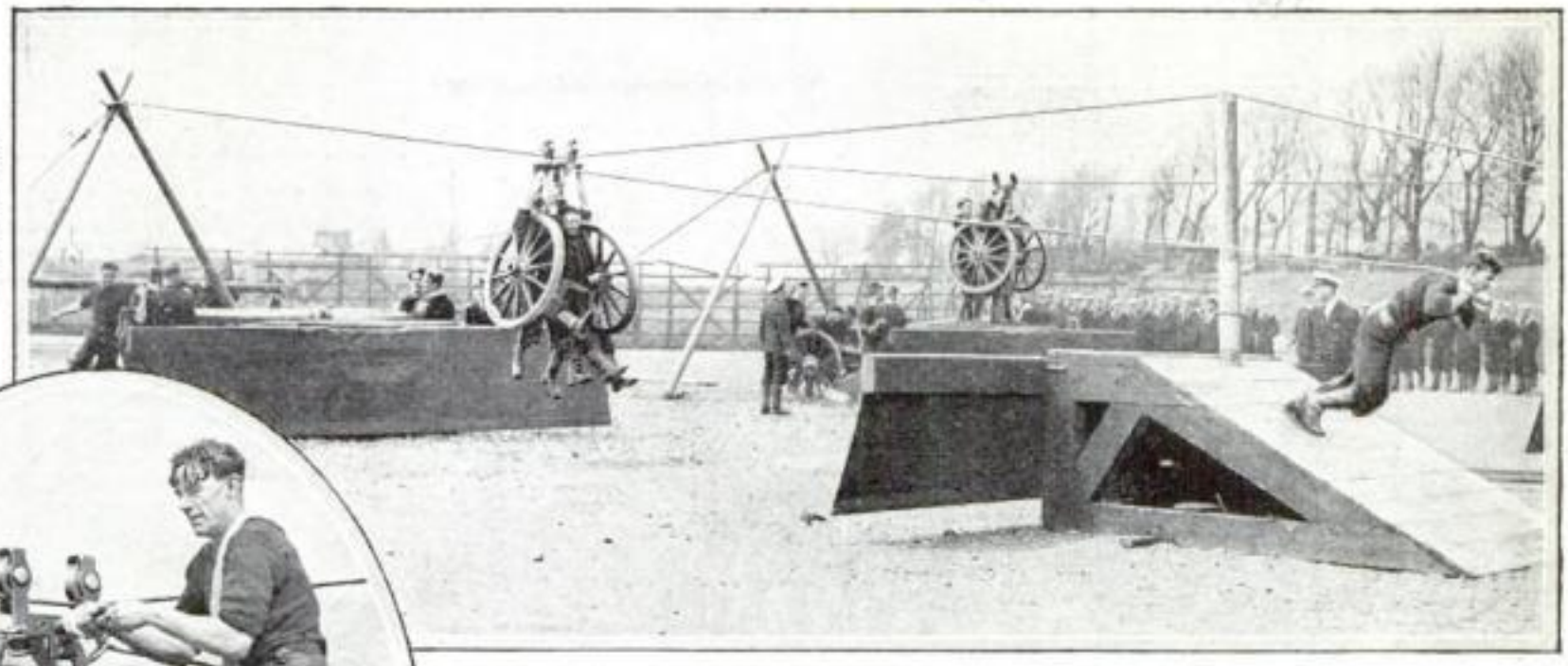


Below, a trooper with the U. S. cavalry unit that has been equipped with radio. He carries aerial and receiving set.

AMERICAN CAVALRY NOW CARRIES RADIO OUTFIT

WHERE Army cavalry are not to be displaced by armored cars, as described on another page of this issue, because of rough terrain over which only horses can travel, this arm of the service is being brought up to date with ultra-modern instruments of warfare. Recently the first radio-equipped cavalry made its appearance during maneuvers on the Texas-New Mexico border. One trooper of the radio service wore headphones and carried a ten-foot stick bearing his receiving aerial. A receiving set hung from his saddle. This cavalryman, trotting beside the commanding general, passed along messages from other divisions and from scouting airplanes. Eight horses carried a sending set with its dynamo and antenna, enabling two-way conversation and dispensing with mounted messengers.

British Tars Move Big Guns Across Fake Chasm

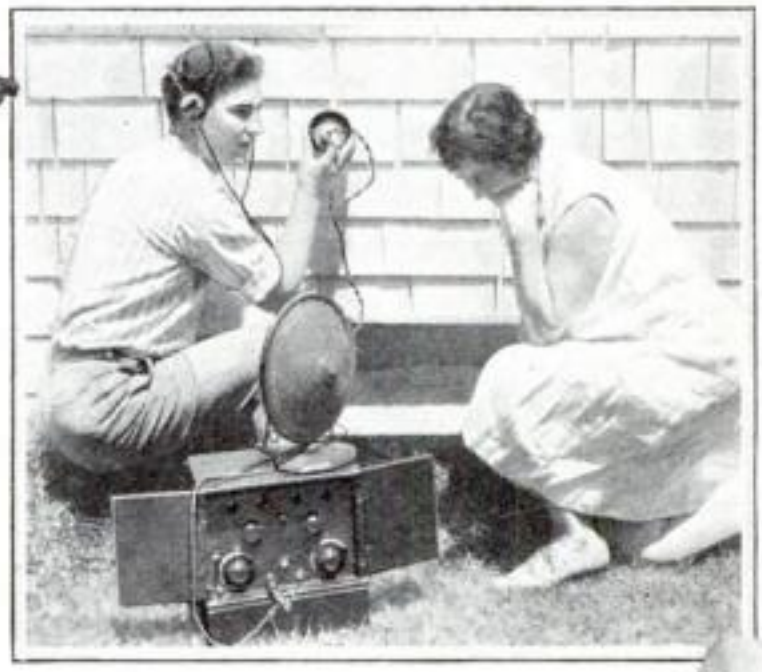


At right, the fake chasm across which British tars swung big guns. Below, the barrel goes over as two sailors ride it.

At the naval gunnery station near Portsmouth, England, the other day British tars staged an odd race to show what sailors could do ashore. Cables were rigged between platforms that represented opposite sides of a chasm in mountainous country. The sailors then transported two field guns and their crews across the chasm on trolleys that ran on the cables. Each gun was "knocked down" into three sections for its odd trip, wheels, mountings, and barrels being taken over separately. As each section crossed the chasm, members of the crew went with it, the load being drawn across by a tow-rope manned by husky sailors. It was a matter of but a few minutes to take the guns apart on one side of the chasm, get them across, and put them together again on the far side. The photograph above shows the wheels being carried across.

PERISCOPE GIVES VIEW OVER CROWD

A western inventor borrowed an idea from the trench periscopes of World War days and evolved the instrument shown below for the sport fan. No matter how difficult it is to get to the front rank of spectators, the user always has a clear view. He has merely to raise his periscope and watch over their heads. In this picture, the girl with the periscope is using it to follow a golf tournament at Los Angeles, Calif. It allows her to see every stroke unobstructed.



USES MIKE TO FIND TERMITES

Termites, antlike insects that attack wooden houses, commit their depredations unseen. Unless the owner detects their hidden mud tunnels, he has no warning until their work is finished. Now a southern California man has patented a sound amplifying device intended to reveal them at work. Pressed against a wall, he says, its microphone picks up the sound of their tiny jaws gnawing through the woodwork, and it is heard as a crashing roar in a loudspeaker.

MAD DOG'S BARK PUT ON AIR

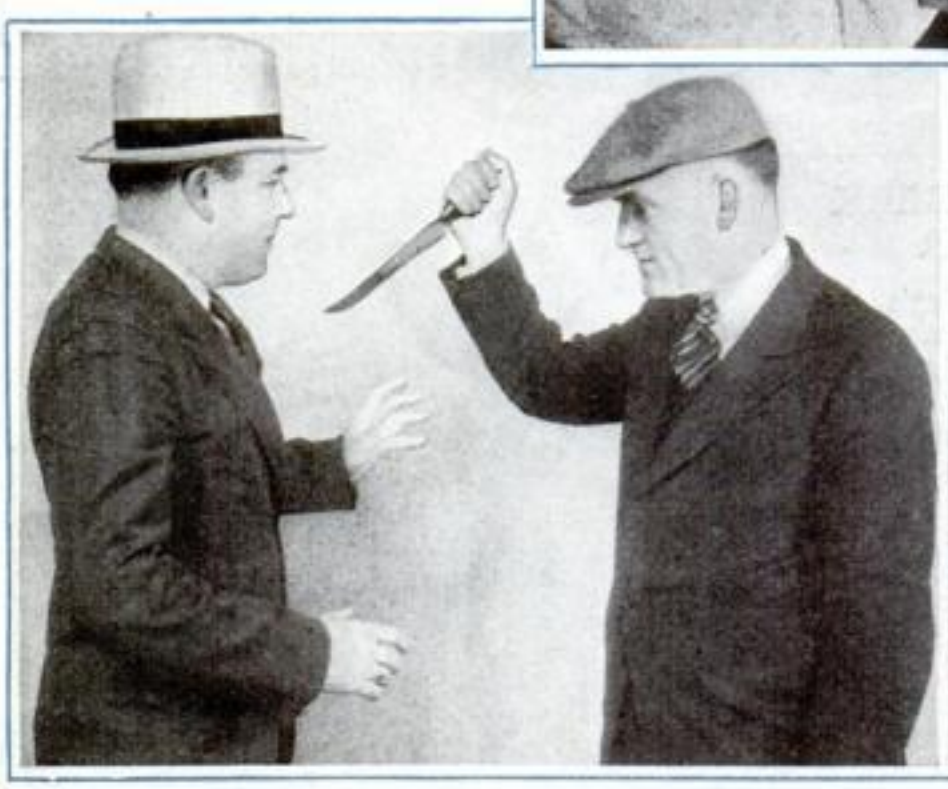
Just what a mad dog's bark sounds like was brought home vividly to Los Angeles, Calif., radio listeners recently. The voice of a caged dog suffering from hydrophobia was recorded on a phonograph record. Then it was broadcast, together with the bark of a normal animal, to warn the public when to keep away from a suspiciously acting dog. The unusual educational experiment was conducted as shown at right by officials of the Los Angeles Department of Health.

Beating *the* Thug *to* His Own Gun

Chicago Police, Trained to Handle Armed Men, Show, in Series of Pictures, How Weapons Can Be Wrested from Footpad

WHAT TO DO AND HOW. Photos on this and following page give a good idea of how officers are taught to disarm a thug even after he has them covered. Above, Sergeant John Leonard, right, and Detective William Foley, of the Chicago Police Department, pose for the first of the pictures in the series that proves that an armed man has not an unbeatable advantage even though he has his weapon in his hand and is desperate enough to use it.

GRABBING THE GUN. Instead of throwing up his hands at the command, the victim, right, with one swift movement, hooks the barrel of the pistol with his right thumb, grips the wrist of the gunman with his left hand, and then, as above, forces the thug's hand back over the shoulder, twisting the weapon out of his grasp. If he puts up a struggle the trigger guard of the revolver will break his finger. Experts move so rapidly that they can escape injury.



BEATING A KNIFE THRUST. Speed is the first requisite in meeting an attack of this kind. The left hand darts under the blade and grasps the wrist of the assailant to check and turn the blow to one side.

RIGHT ARM MUST HELP. Then the right hand is thrust quickly under the crook's knife arm above the elbow so that, as the wrist is pushed back, the arm is twisted at the shoulder (see opposite page).

ATTACK FROM REAR. When a gunman thrusts a revolver into his victim's back, he apparently has an unbeatable advantage.

KNIFE GRIP IS BROKEN. In the position above, the knife hand is forced so far back that the crook has to let go of his weapon.

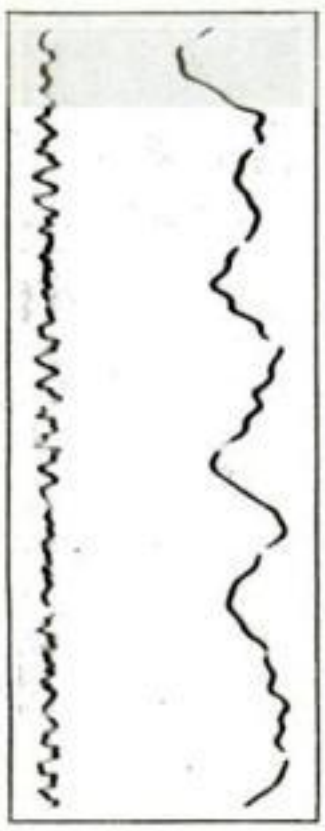
SPEED AND STRENGTH WIN. At the attack from behind, the victim swings his body suddenly to the right so that his right arm, held stiffly away from his side, strikes the wrist of the thug, throwing it to one side as shown above. Then, at left, is seen the off-balance position into which this maneuver throws the criminal. The victim's right arm continues around the gun arm and his fingers grip above the elbow. At the same time, with his left hand he seizes the barrel of the revolver. Below, this leverage makes it possible to twist the hand so far back over the robber's shoulder that he can no longer keep his grip on the butt of the gun and it is easily taken away by his intended victim. Each of these movements, of course, calls for the greatest possible speed and sufficient strength.

New Machine Proves Skyscrapers Shiver in Wind

When a wind strikes these towering buildings of New York they sway several feet from perpendicular.

IN NEW YORK CITY is a man whose job has no counterpart in the country. He is David C. Coyle, consulting engineer, and his self-appointed task is watching skyscrapers sway and shiver in the wind.

Strange things happen when a stiff breeze hits a structure of forty stories or more. Office workers sometimes can feel the building move, and they may even become seasick. This odd "sky sickness" has been traced to the swaying of objects in the room. Hanging lights in one New York office building swing several feet, though the building moves only a fraction of an inch.



Line on the left is record of high building's tilting motion and on the right is "shiver" line, which shows sideward sway.

Tall structures such as the Empire State Building, the Chrysler Building, and the Manhattan Company Building in New York are carefully planned so that they can bend without breaking. Architects built the 925-foot Manhattan Company Building so that it could swing out toward the sidewalk as much as two feet in a wind. Equally flexible is the Empire State Building, upon which engineers have calculated the wind may exert a total overturning force of 4,250,000 pounds!

Hitherto engineers have planned the ability of skyscrapers to "give" in a wind largely by rule of thumb, with a generously ample margin of safety. But now as even taller towers are proposed, engineers for the first time have become acutely conscious that no one has measured, as a guide, the behavior of tall buildings in a wind.

That is where David C. Coyle comes in. Not long ago he invented an instrument, patterned after a seismograph, or earthquake-detector, to measure and record a building's "shivers" in the wind.

Every building that he has observed so far has proved more than adequately safe.

David C. Coyle, engineer, with the machine he has invented to study the sway of high buildings.

Each skyscraper has an individuality in its response to gusts of wind, Coyle finds. The wavy lines recorded on his instrument's charts show that one building often shivers as many as forty times a minute; some of the newer, "slower" towers, as few as eight. It is these small but repeated vibrations that make lamps swing several feet and waves rise in bathtubs. From Coyle's records, engineers obtain data to aid in planning future towers.

On a windy day, Coyle takes his machine to the top of a skyscraper. He levels it exactly, with three adjustable screws, and sets it in motion. Within the apparatus are two delicately balanced levers—one to record how far the building moves sideways; the other how much the floor tilts.

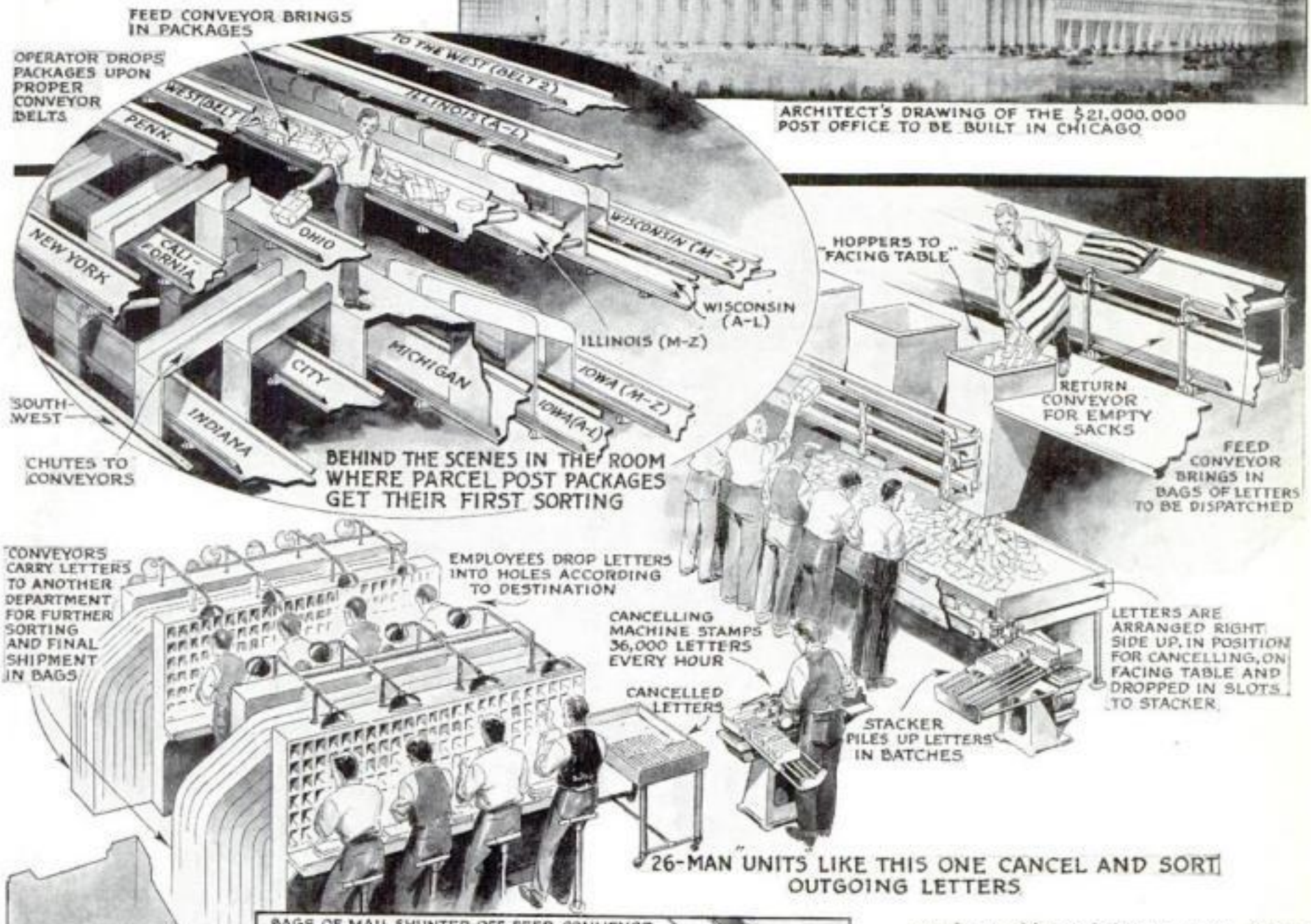
Each lever carries a mirror that reflects a beam of light upon a moving roll of photographic paper. When the paper is developed it bears two wavy lines, side by side, showing the building's sideways and tilting movement.

Biggest Post Office TO BE BUILT IN CHICAGO

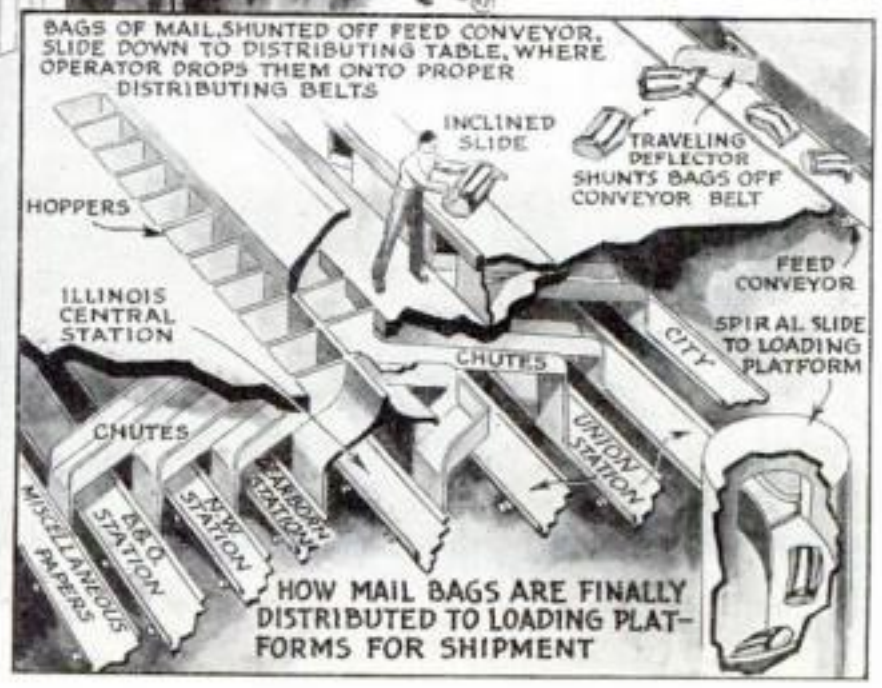
CHICAGO is to have the largest post office in the world. The fifty-acre, twelve-story building will be completed and ready for occupancy within about a year and a half, according to a recent announcement of the United States Post Office Department. It will be able to care for the 19,000,000 letters a day expected by 1943, in addition to the parcel post packages and newspapers. In one year, it is estimated, the total amount of mail handled would be sufficient to fill completely a structure four times its size.

More like a factory than a post office

ARCHITECT'S DRAWING OF THE $21,000,000 POST OFFICE TO BE BUILT IN CHICAGO



MAIL HANDLED BY NEW POST OFFICE IN ONE YEAR WOULD COMPLETELY FILL A BUILDING FOUR TIMES ITS HEIGHT

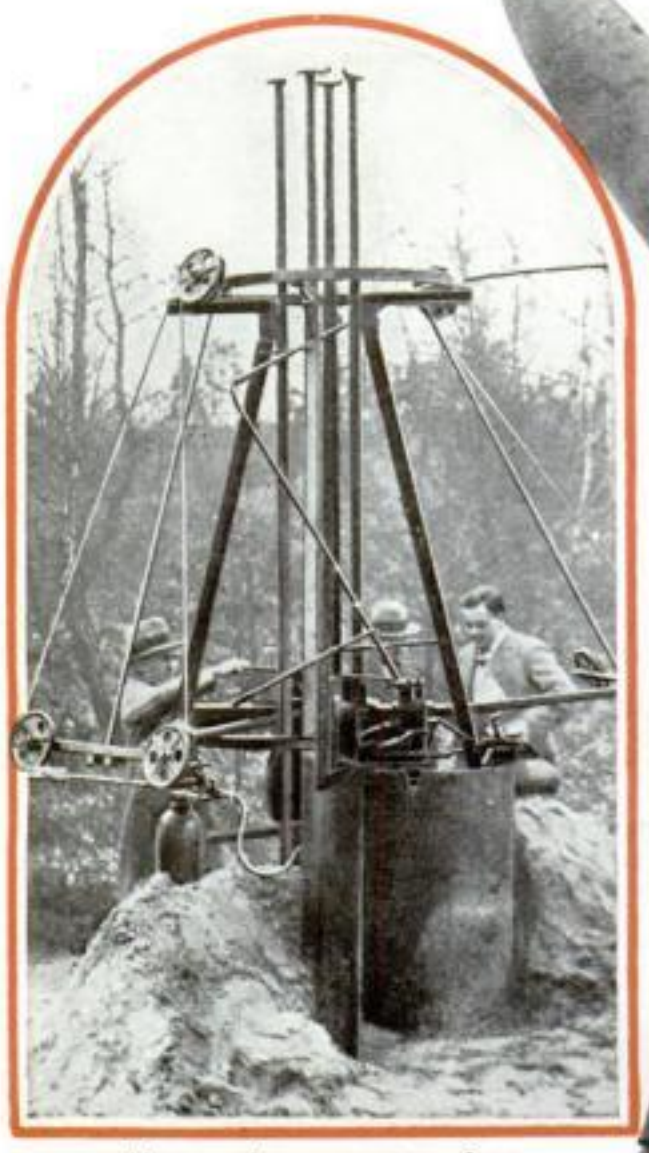


are the workings of this structure. Motor trucks, one every minute, will bring in letters from collection boxes throughout the city. These letters will be shot upward in elevators to the upper floors, and travel by gravity down through the building. By the time they reach the ground floor they will be canceled, sorted, and ready for dispatch by train or airplane. On this page our artist shows some of the mechanical devices behind the scenes that will speed letters.

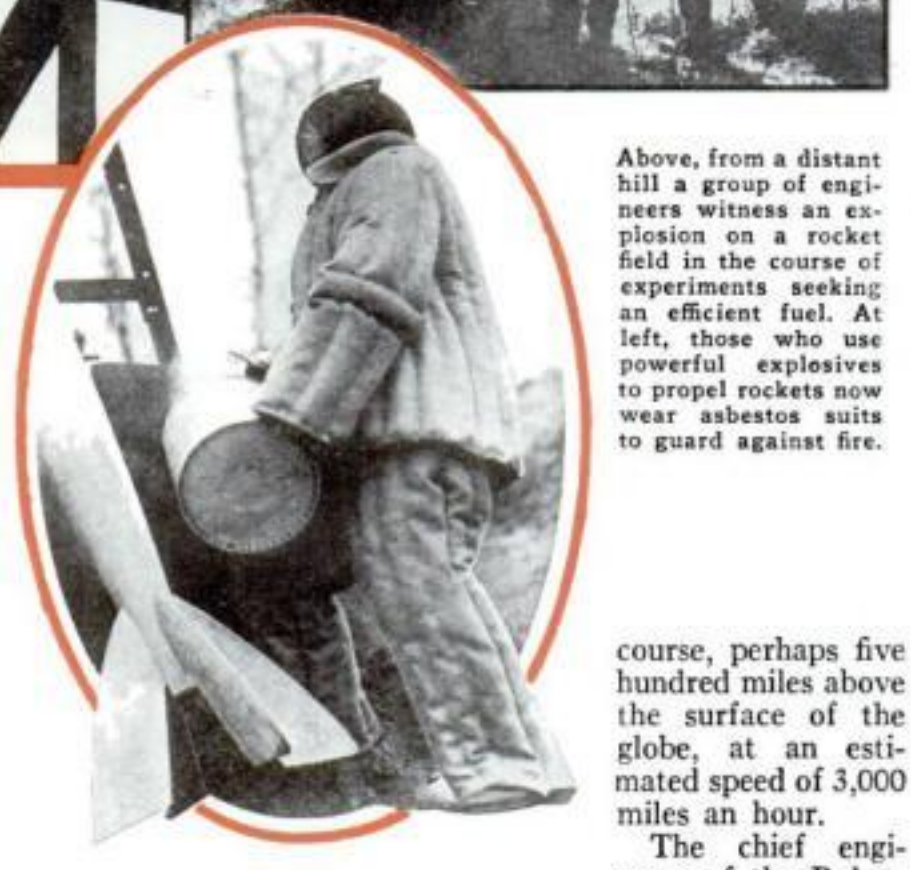
In the parcel post room, for example, an attendant drops packages from a main belt upon conveyors that classify them by states. Where the volume of mail requires two conveyors for one state, mail for cities with the initials "A" to "L" goes on one belt, and "M" to "Z" on the other.

Daring Men in Seven Nations Aim to Harness

GIANT ROCKETS



Above, the apparatus from which a test rocket is launched or which is used to hold the rocket motor in fuel experiments. At right, a small rocket is put in the launching machine.



Above, from a distant hill a group of engineers witness an explosion on a rocket field in the course of experiments seeking an efficient fuel. At left, those who use powerful explosives to propel rockets now wear asbestos suits to guard against fire.

FIFTEEN years ago the rocket was a toy, fit only for fireworks or laboratory demonstrations. Twelve years ago only one scientist in the world, the American physicist, Dr. Robert H. Goddard, of Clark University, Worcester, Mass., was working to transform this ancient plaything into a source of power for fast vehicles. So rapid has progress been, since then, that today the rocket is a young giant, though as yet too impetuous and uncontrolled for commercial use.

Scientists and daring men of seven countries, including the United States, are making serious and audacious tests that may soon solve the problems connected with this form of transportation.

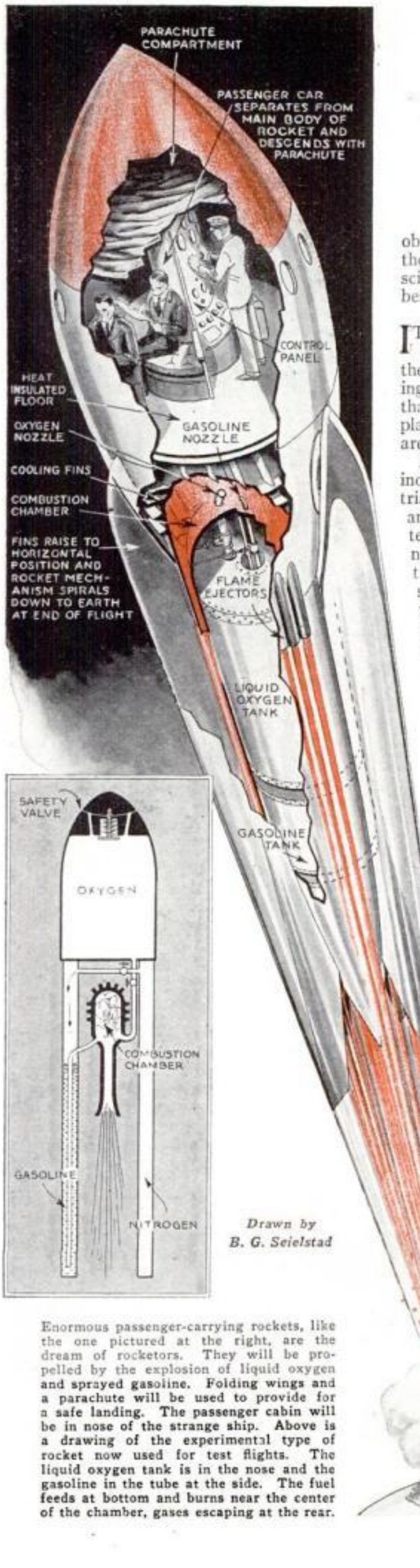
A few weeks ago I visited the Raketenflugplatz at Berlin, the world's most extensive experimental ground for the study of rockets. It lies in Reinickendorf, not five miles from the heart of the German capital, and sprawls northward into the hilly, tree-protected country surrounding the metropolis. At this plant, larger than the famous flying field at Tempelhof, six engineers are working seven days a week to accomplish the miracle of harnessing giant rockets.

The name Raketenflugplatz means "rocket flying field." It was not without design for the future that the Verein für Raumschiffahrt, the German society supporting these experiments, laid out so large a field. Within five years, the engineers there have predicted, rockets carrying mail will leave and arrive at the Raketenflugplatz on schedules, connecting all Europe by fast projectiles.

When this first objective has been safely accomplished, the workers of the German society will be ready to try a more ambitious project. This will be the shooting of a mail rocket across the Atlantic, to land somewhere near New York, with a cargo of letters or valuable express.

Such transatlantic rockets will be the forerunners of great rocket ships built to carry crew and passengers. They will cross the ocean from New York to Berlin in an hour, or two hours at the most, rising through the thick lower atmosphere on wings like those of an airplane, then speeding through the upper part of their course, perhaps five hundred miles above the surface of the globe, at an estimated speed of 3,000 miles an hour.

The chief engineers of the Raketenflugplatz are Rudolf Nebel, Willy Ley, and Klaus Reidel. They have announced that transatlantic passenger flights will not content them. Supported by a society of more than 1,000 enthusiasts, these German engineers hope some day to launch from their rocket field a bullet-shaped craft destined for the moon or one of the planets. They see no theoretical reason why it cannot be done, though difficult mechanical problems raise many practical



Drawn by B. G. Seielstad

Enormous passenger-carrying rockets, like the one pictured at the right, are the dream of rocketors. They will be propelled by the explosion of liquid oxygen and sprayed gasoline. Folding wings and a parachute will be used to provide for a safe landing. The passenger cabin will be in nose of the strange ship. Above is a drawing of the experimental type of rocket now used for test flights. The liquid oxygen tank is in the nose and the gasoline in the tube at the side. The fuel feeds at bottom and burns near the center of the chamber, gases escaping at the rear.

This article tells you the sensational facts the author learned while making a personal tour of the world's rocket fields where elaborate tests are now under way.

By G. EDWARD PENDRAY

obstacles. But one by one, through the coöperation of rocketors and scientists all over the world, these are being overcome.

IT MUST not be assumed that, because their project is the largest, the Germans are the only ones working on the rocket problem, or indeed that the Raketenflugplatz is the only place in Germany where experiments are under way.

At present there are groups and individuals working in Germany, Austria, France, Italy, Russia, Roumania, and the United States to solve the technical barriers to the use of this new engine. In each of these countries the program is essentially the same—first an altitude rocket that will go up fifty, a hundred, or two hundred miles, to the extreme limit of the earth's atmosphere, driven by powerful liquid fuels and properly equipped with scientific apparatus and a parachute to bring both rocket and instruments safely back to earth. Then mail rockets, under control from start to destination, shooting between cities, bearing commercial traffic at enormous speeds, to be followed by rockets capable of crossing the oceans or encircling the world, carrying freight and passengers. Finally, powerful ships of space, roaring to the moon or to our other neighbors in interplanetary space.

As you read these words, the first high altitude rocket may be hurtling upward from any one of nearly a score of experimental stations here and abroad, penetrating into that borderline between atmosphere and space that no instrument made by man has so far touched. When that has been accomplished we may look for the rapid development of rocket traffic, for the greatest problem is that of applying tremendously powerful liquid fuels in such a way as to get the full energy without bursting the rocket.

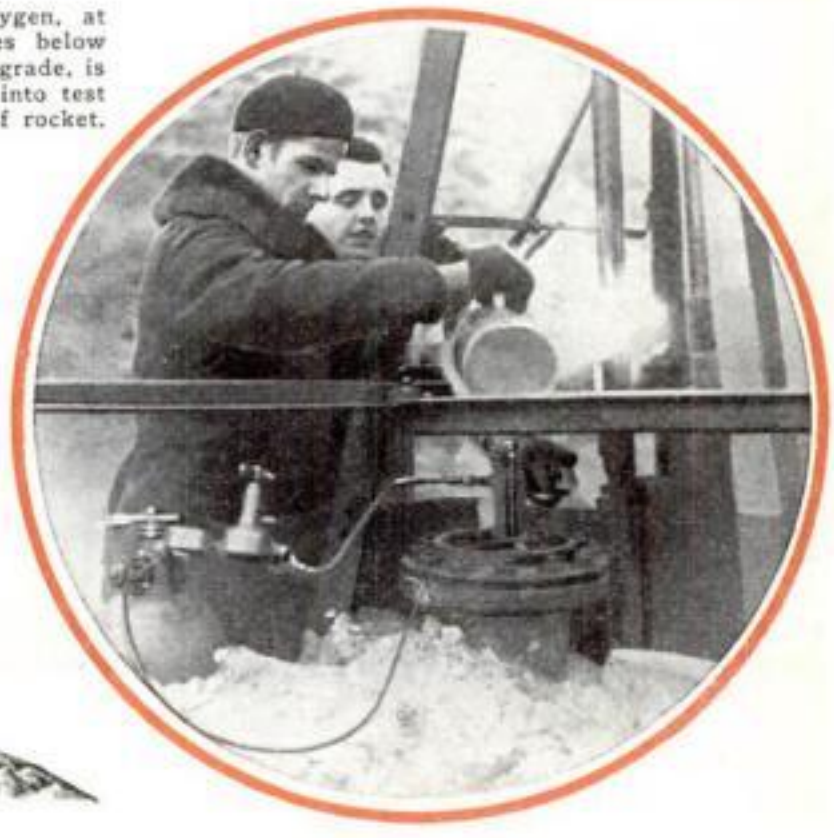
The fuel at present being experimented with by the Germans consists of liquid oxygen and gasoline. The oxygen is necessary because the combustion is so rapid that it could not be supported by the oxygen of the air. The handling of the oxygen is one of the chief difficulties. To keep it liquefied it must be maintained at a temperature colder than 183 degrees below zero, Centigrade. At this temperature even mercury is frozen, and special, elaborate containers must be used to handle the liquid.

ABOVE this temperature the oxygen boils furiously, giving off quantities of oxygen gas. If the container is closed to prevent free evaporation a tremendous pressure is created almost instantly, and if no provision is made to relieve it, the container will burst with a terrific explosion.

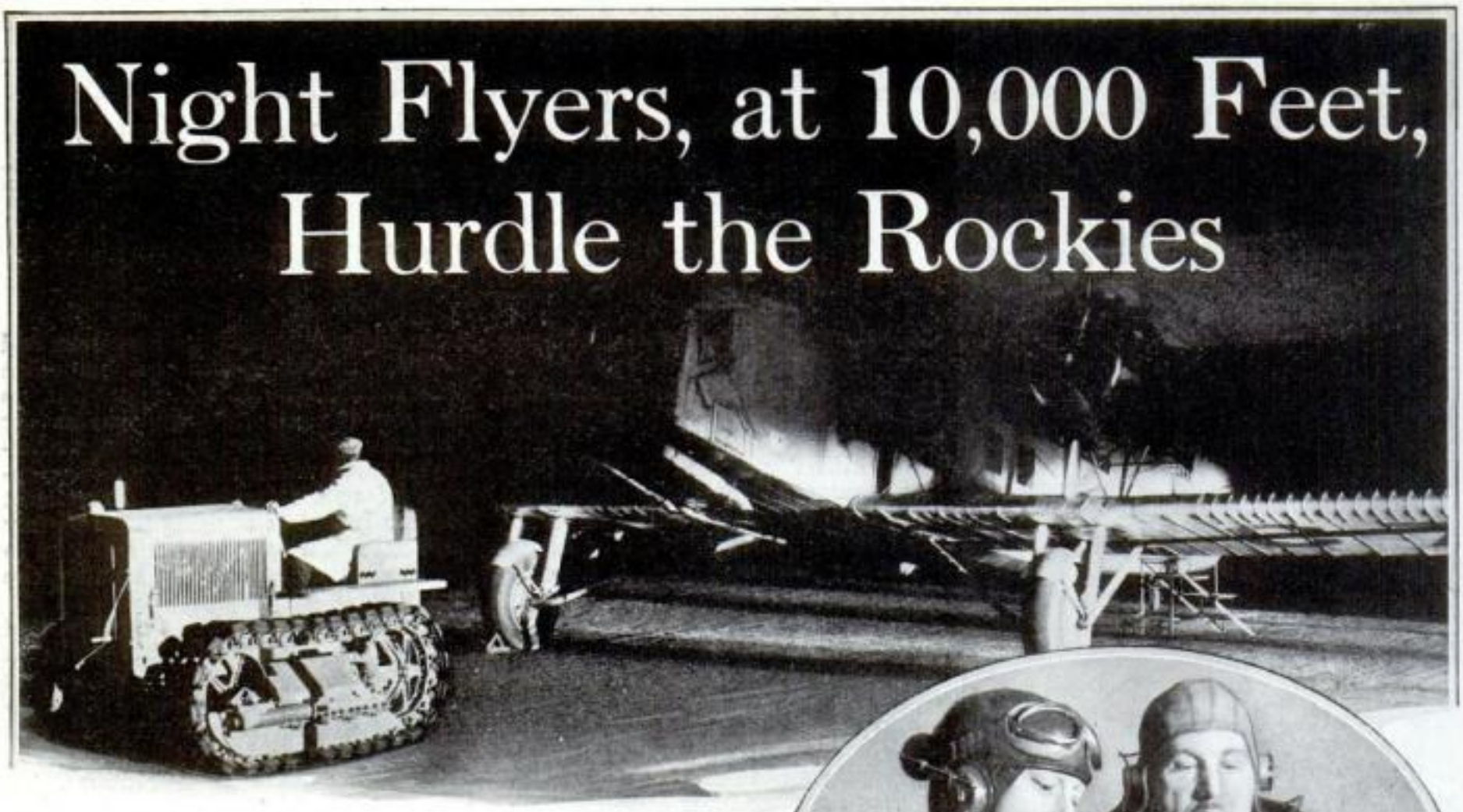
During the rocket's flight the oxygen fuel must be kept cold, yet under sufficient pressure to force it rapidly into the combustion chamber, which is the motor of the rocket. There, not many inches from the extreme cold of the oxygen, a temperature as great as that of the oxy-acetylene flame exists, fed by continuous streams of gasoline and oxygen.

A most important problem, and one that has not been *(Continued on page 120)*

Liquid oxygen, at 183 degrees below zero, Centigrade, is being put into test reservoir of rocket.



Night Flyers, at 10,000 Feet, Hurdle the Rockies



Above is a tractor preparing to tow to the hangar one of the huge planes that are used to carry passengers and mail across the Rocky Mountains.

The author, left, checks a weather report.

A veteran pilot's thrilling story of hazards met in big planes over America's toughest flying country

By HARRY W. HUKING

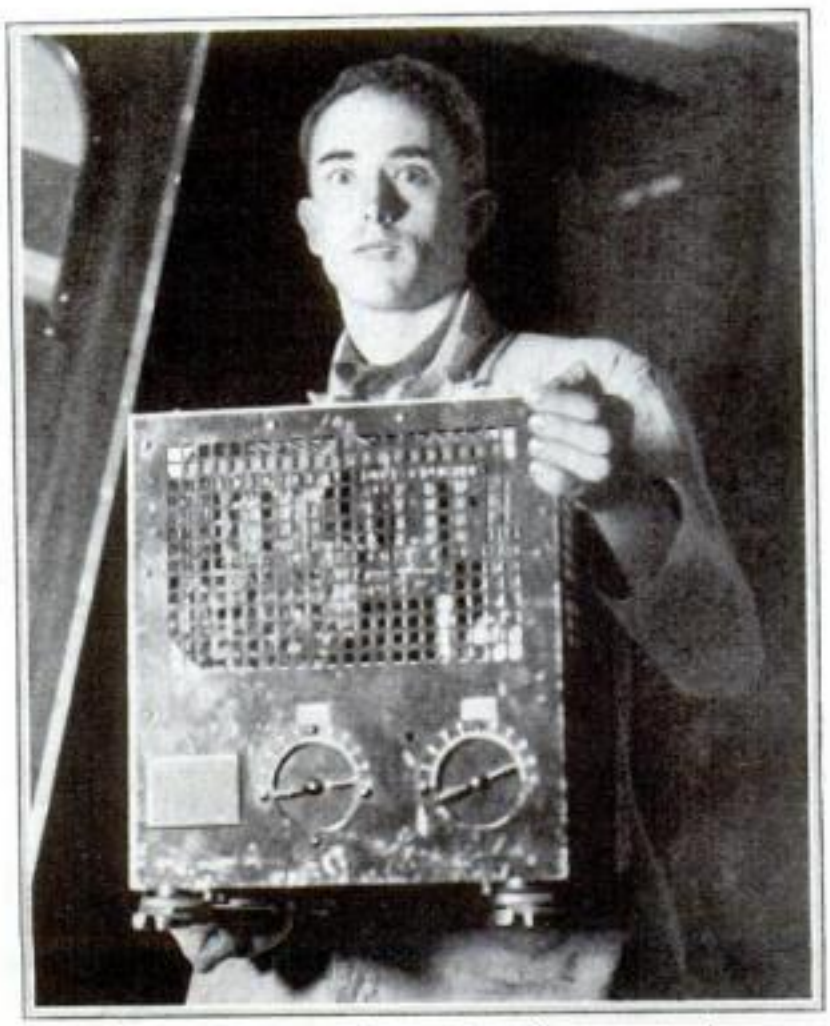
TEN thousand feet in the air. Around me the blackness of a cloudy, moonless night. In my ears the roar of three powerful motors. In the cabin back of me, passengers and mail for whose safety I, and I alone, am responsible.

Before us is the great Hump of the Rocky Mountains, rising to more than 9,000 feet. A swift down-current of air, an instrument gone momentarily wrong, a slight miscalculation, and the great plane in which we ride will hurl itself against a mass of granite—and we shall have made our last flight.

Yet for nine years, for 1,200 nights, I have hurdled the mighty Hump and not once have I been forced down by mechanical trouble. Storms roar out of the canyons and sweep around the peaks, clutching for plane, pilot, and passengers, but of these we are now forewarned by radio—that best friend of the night flyers.

These we dodge, if possible; going over or under or around them. Failing thus to escape, we seek one of the emergency fields and sit down until the elements calm themselves. But we did not always have this unique factor of safety.

Back in 1920 there were no radio eyes and ears to tell us what we were running into, and it was that condition that led to my most thrilling experience and narrowest escape. Soon after I left Reno on one of those early trips, I ran into a bad storm. Vainly I tried to get under or over or around it. Each attempt failed. There were no emergency fields in those days and there was nothing for me to do but grit my teeth and try to fly through the snow- and sleet-laden gale.

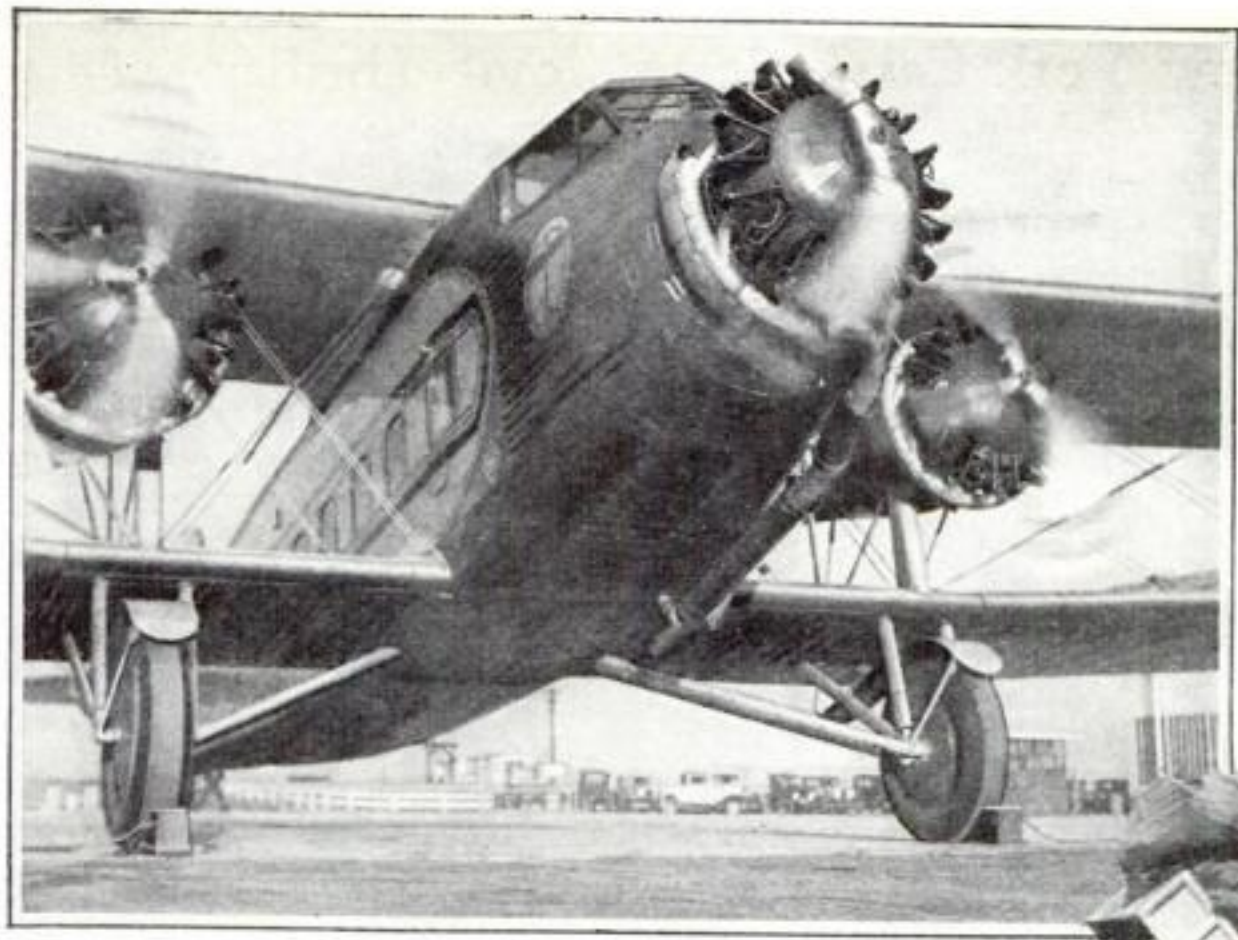


After each trip over the Hump, the radio apparatus is carefully overhauled. Here a mechanic is taking it to the shop.

UPWARD I tilted the nose of the Liberty-motored DeHavilland and let her climb. Somewhere up there, I thought, there must be calm weather. At 17,000 feet, the wind was less furious and I began to exult in the belief that I had actually won through. My joy was short lived. At that instant the Liberty engine began to give trouble.

Its climbing power was gone. Worse than that, it could not hold the altitude we then had. Down we went, dropping swiftly into the whirling storm clouds from which I had thought we were clear. Down, down, far below the 10,000-foot mark at which lay safety. Where we should have been nearly two miles above the earth, the altimeter told me we were only 2,600 feet up.

I knew that no ship could live at that height in the midst of the crags hidden by the darkness. A crash was inevitable. It came.



This giant mail and passenger plane flying nightly across the dangerous Hump is powered with three Hornet engines, capable of developing 1,575 horsepower.

When I awoke, five days later, I found myself in a hospital room. The plane had struck a tree and left both right wings among its branches.

THAT accident occurred nearly eleven years ago. Since then I have spent 5,000 hours flying back and forth across the Hump without damaging a plane or hurting myself or any passenger. Science and mechanics, combined with the greater skill due to experience, enable us to avoid such conditions or, if we do meet them, to fly out.

The crash that nearly ended my flying career was caused by ice forming on the carburetor and choking off the gas. Today hot air heaters keep ice away from the carburetor in even the most severe weather. In the old days, when caught in a storm, we either flew through or crashed. Now, in such an emergency, we land on one of the intermediate fields or follow the radio to clear weather.

As you see, in the old days night flying was to a considerable extent blind flying. Today we take off from the Oakland airport at eight in the evening with a ton of mail and twelve passengers and confidently head into the blackness toward Reno, Cheyenne, and Chicago. Everywhere along the 1,900-mile route ground observers send us uninterrupted reports of weather ahead. Frequent lights guide us on the right path, and there is an emergency field every twenty miles. Almost all of the time we are within gliding distance of some field.

EVEN while climbing one side of the Hump and gliding down the other we are near a field. Three landing places have been built to make the trip safe. The Hump is just what the name implies. It is a ridge of mountains in California lying between Truckee on the east and Soda Spring on the west. The mountains seem to jump straight up from Truckee, at an elevation of 6,200 feet, and in an eight-mile airline they climb 3,000 feet. Then they start falling off on the west slope, until the surface of the earth reaches sea level at Sacramento, seventy miles away.

AT NIGHT we fly over the Hump at 10,000 feet. From Oakland, flying east, we cross the Berkeley Hills at 3,000 feet. From Sacramento we begin to climb. If weather is clear and the wind is not pushing us along too fast, we climb steadily so that we reach 10,000 feet before crossing. Sometimes we circle several times to get altitude before reaching the crest.

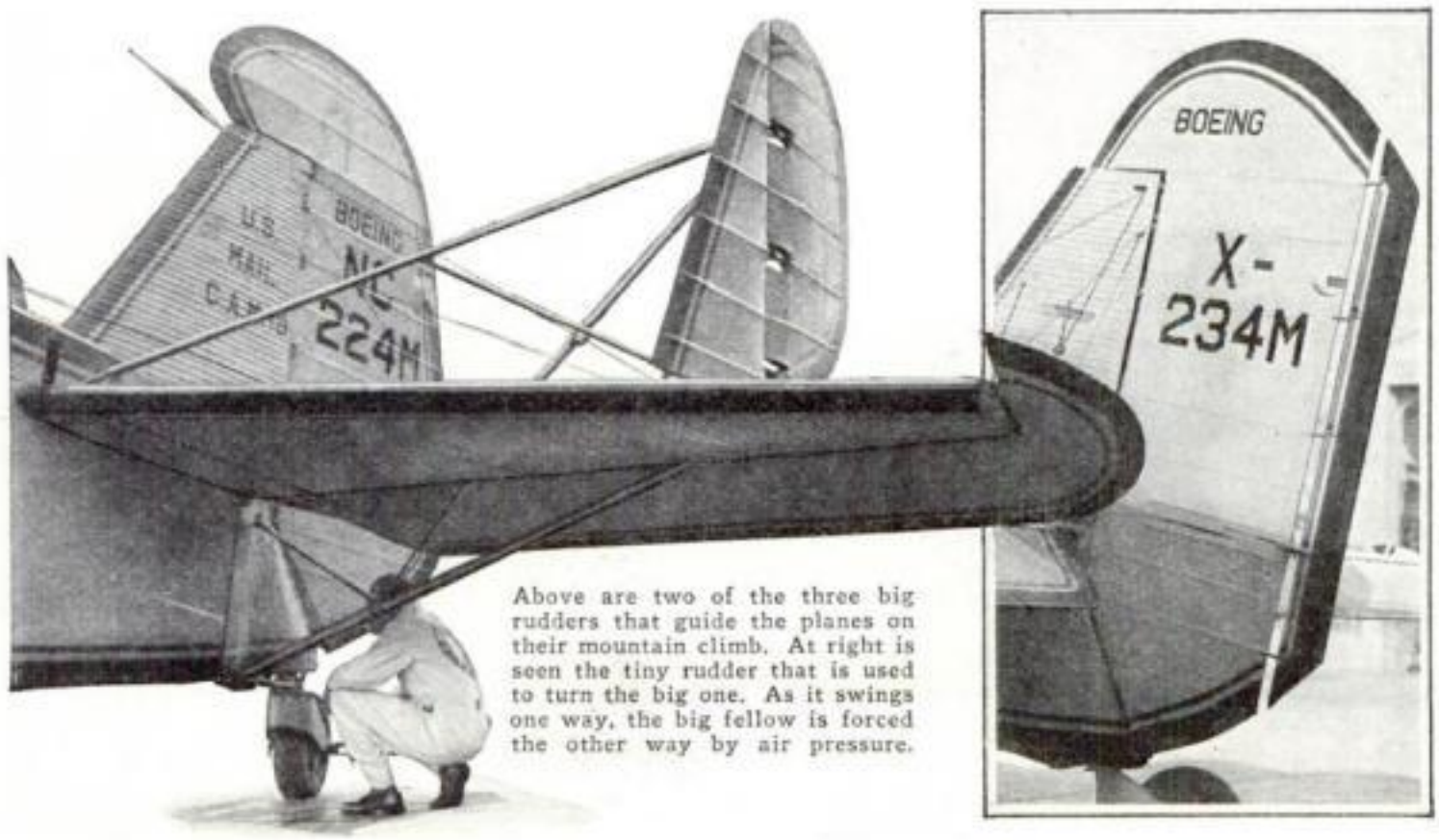
Here is part of the load that one of the big transport planes has brought in. A ton of mail and express is carried each trip.

I recall one night in the old days when we circled an hour over Blue Canyon in descending currents of air, unable to gain altitude. Then we flew into a current moving upward and soon had reached 15,000 feet, at which height we caught a tail wind that blew us over. We soon landed at Reno.

While we can get over the Hump at night as low as 9,000 feet and during the day at 8,400, we never go through at those levels. At those altitudes the pilots must wind around canyons. In fact, at 8,400 feet the plane at some points will be lower than the railroad tracks on which transcontinental trains run.

It never is necessary to fly lower than 10,000 feet, even with a full load of mail and passengers. With 1,575 horsepower pouring out from the three Hornet engines, one of the big ships can climb from sea level to an altitude of two miles in twelve minutes.

Brilliant lights attached to the lower wing, together with safe automobile-type brakes on the wheels, enable us to bring one of these planes, *(Continued on page 113)*



Above are two of the three big rudders that guide the planes on their mountain climb. At right is seen the tiny rudder that is used to turn the big one. As it swings one way, the big fellow is forced the other way by air pressure.

Bootleggers' New York Castle Beats Movie Thriller

Above, the brick walls of this bootlegger's castle would swing open so a truck could be quickly loaded. At right top, haul made when the castle was raided. Right, pressing this button opened trapdoor in floor.

SECRET trapdoors that swing ponderously upward at a button's touch, and apparently solid walls of brick that open on hidden hinges—such scenes as these, hitherto found only in movie thrillers, greeted the eyes of prohibition agents the other day when they raided a veritable bootleggers' castle in the heart of New York City. Behind these ingenious barricades they found a huge alcohol distillery. Biggest discovered since prohibition began, it had been turning out 30,000 gallons of alcohol a day—enough to fill three ordinary railway tank cars. For a blind, a garage had been operated on the ground floor of the six-story building. A side door led to an office, where the agents found a hidden button that opened a trapdoor in the floor and revealed a stairway. It took the agents four hours to thread their way through secret passages to the stills. They found the building deserted. An elaborate signal system of telephones, lights, and gongs had evidently given the alarm of their approach. Inside the garage itself they found a false wall that swung open, so that a truck backed up to it could be loaded with drums of alcohol from an efficient conveyor. When the panels were closed, the garage resumed its innocent appearance.

TALK WASTED ON FROGS

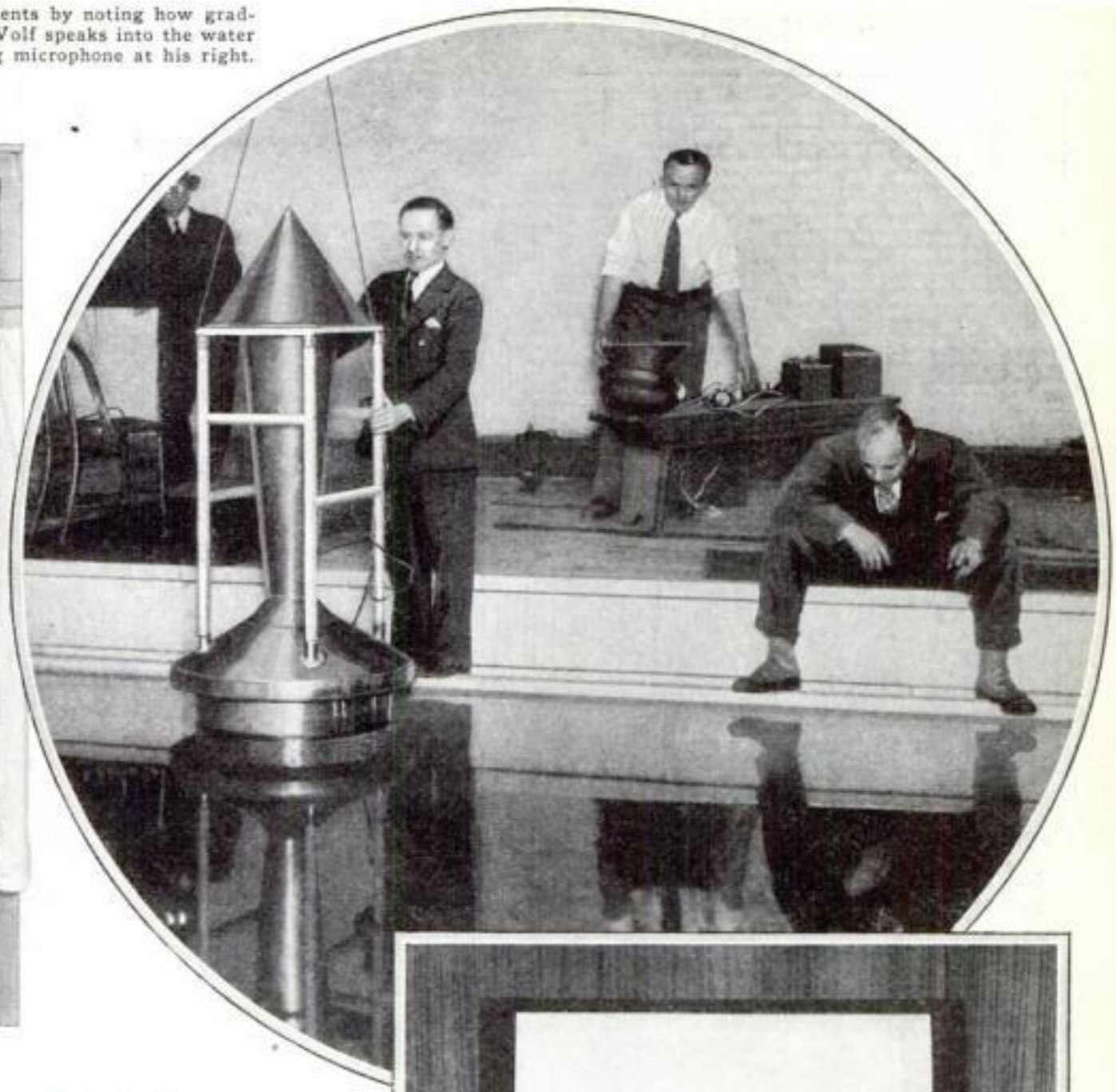
IN MAKING tests to find how hearing "works," research workers at Princeton University, Princeton, N. J., have found that bullfrogs and turtles are deaf to human speech. The only sounds that are audible to these creatures are those that resembled the croak of the bullfrog.

NEW ULTRA-VIOLET LAMP WILL LIGHT HOME

RECENTLY invented, a new kind of ultra-violet lamp for home and office contains the health-giving rays and is also suitable for general illumination. Its light is white with a slightly bluish tinge. The light comes from a small spiral of glass tubing, which contains mercury vapor and a secret mixture of rare gases. When the current is turned on, the tube becomes luminous after the fashion of neon advertising signs. The combined luminosity of the gaseous ingredients is said to give a light containing all the natural rays of sunshine. This is the first ultra-violet lamp to combine the light of mercury vapor and of luminous gases, although other recently developed lamps use a combination of mercury vapor with an incandescent metal filament. The new lamp is still in the experimental stage, but is being tried out in actual service in a New York office.

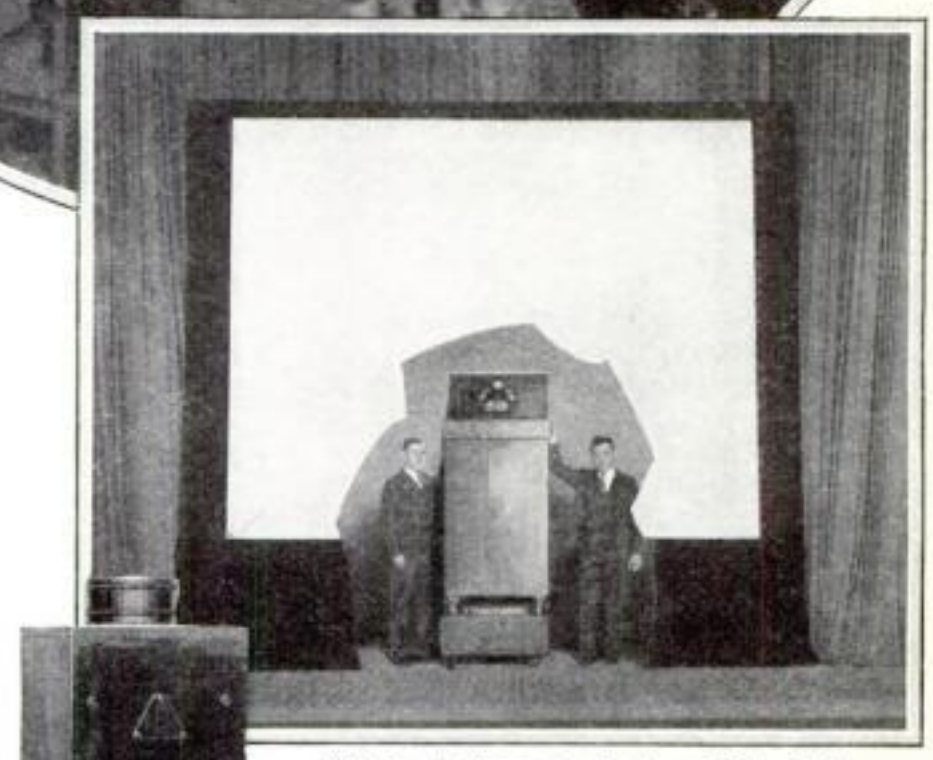
At left, this photo was taken by the light of a pair of the new ultra-violet lamps that combine the sun's beneficial rays with general illumination. The girl at the typewriter is using one of them. Above, note the spiral glass tubing that contains mercury vapor and a mixture of rare gases that are luminous when electric current is turned on.

Below, Volf making his first experiments by noting how graduated tubes resonated sound. Right, Volf speaks into the water and sound is picked up by the floating microphone at his right.



Floating Mike

Gives New Voice to TALKIES



Above is shown a giant model of the water tank loudspeaker in a talkie theater. At the left, a tiny model for the home.

EVERY schoolboy knows that sound carries best over water. But it remained for Christian A. Volf, Jr., New York acoustical engineer, to build this idea into a loudspeaker and a method of recording sound for talking pictures.

Recently Volf exhibited two models of a new loudspeaker with a trough of water built into the base to project into the air sounds directed against it by a series of pipes.

One of them, a little wooden cabinet scarcely twelve inches high, is a loudspeaker intended for the home radio set.

The other, a huge cabinet considerably taller than a man, has just been installed behind the screen of a New York talkie theater. It can successfully reproduce the full-throated sound of a symphony orchestra or a great chorus.

Both models direct sound from conventional loudspeaking units downward through resonating tubes like organ pipes, all of different sizes, designed to enrich the tones. The sound then strikes the water and is carried to the listener.

After reflection from the water trough in the Volf speaker, the sound is "non-directional," with the result that a member of the audience hears equally well no matter in what part of the theater he is seated. Because of the combination of pipes and water trough, high and low pitched sounds are faithfully rendered. Less power is needed to run the Volf speaker than other types that project the sound straight through the screen, since the new instrument conveys the sound around it.

Four years ago Volf started his experiments by noting the way in which a graduated series of tubes resonated the sound. Since then he has built sixty-seven different models of loudspeakers in his search for the type he has just perfected. Its ability to diffuse sound, instead of projecting it like a searchlight, may bring talkies to theaters with bad acoustics.

An entirely new system of sound recording for motion picture studios is another application Volf discovered for the principle of using water as a tool in acoustical apparatus. In such a studio, microphones would not be suspended in the air. They would float in a water-filled canal encircling the sound stage. They need not be near the speaker, tests have shown, for his voice would strike the moat at the nearest point, and would be transmitted with undiminished intensity to the floating microphone some distance away.

For this purpose Volf has designed a new type of microphone inclosed in a cone-shaped housing. An upward current of warm air, created by electric lamp bulbs in the hollow base, leads sound waves from the water's surface to the microphone concealed in the upper cone's tip.

GRAMMAR SCHOOL PUPILS RAISE CASH FOR OBSERVATORY

SCHOOLBOYS of Wilmette, Ill., search the heavens, following the stars in their course, through an astronomical telescope in a public school observatory. This, believed to be the only grammar school observatory in the United States, was paid for by money that school pupils contributed over a period of six years. The housing and mounting for the six-inch telescope is similar to but smaller than those found in larger observatories. A round structure, topped off by a hemispherical rotating roof, houses the telescope, enabling it to be trained on any part of the sky visible from the Wilmette public school in which it is installed. The telescope was built by the firm that constructed the great forty-inch instrument at Yerkes Observatory, Williams Bay, Wis. The installation of the telescope has greatly increased the pupils' interest in astronomy, according to the instructors.

Pupils at a Wilmette, Ill., grammar school using the telescope in the only grammar school observatory in this country. For six years the children contributed funds to build the observatory.

MOTOR NOW HITCHED TO PENCIL SHARPENER

AN ELECTRIC motor drives a new pencil sharpener that makes quick work of its job. A pencil is held in an opening at one end of a transparent casing like those seen on hand-operated sharpeners. Then a little switch on top of the motor is thrown and the little machine, humming softly, sharpens the pencil neatly and quickly. Unlike most hand-operated sharpeners, which can take but one size of pencil, the new motor-driven machine has a series of different-sized openings in its casing, enabling it to be used to sharpen almost any standard-sized pencil.

NEW MACHINE DOES FOUR FARM JOBS AT ONCE

THE "culti-mulcher," a new farm implement, does four jobs at once, thereby saving time for the farmer. The machine was demonstrated at the Federal experimental farm at Arlington, Va., a short while ago, and received much favorable comment from officials.

The new farm cultivating machine combines the old spring tooth harrow, the roller, and the grain drill. At one time around the field a farmer can loosen up the soil, put in fertilizer, seed the land, and leave it rolled free of all lumps. In the past, three or four trips around the field were necessary to do this work. The soil is left packed just enough to prevent the escape of moisture. It is pulled with a team of horses or a tractor.

This machine saves time by cultivating, fertilizing, planting, and rolling at once.

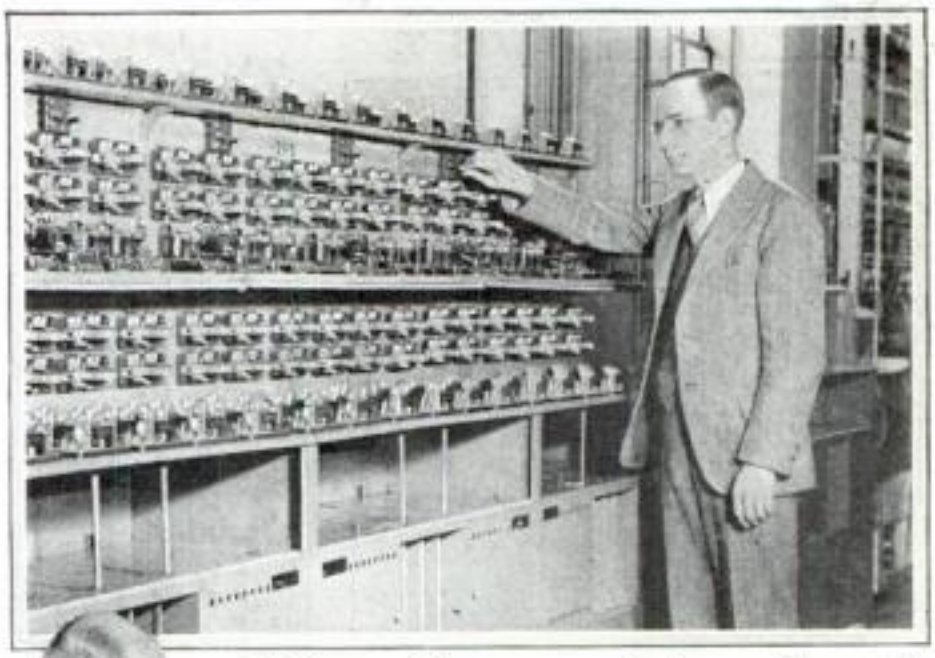
LOCOMOTIVE TENDERS BIGGER THAN SWIMMING TANKS

LARGEST of locomotive tenders are two now being tried out with fast passenger engines of the Pennsylvania Railroad. Each can carry twenty-five tons of coal and 25,000 gallons of water. The capacity of their tanks is thus greater than that of many swimming pools. Use of these tenders is expected to eliminate some of the fuel and water stops on long runs. When fully loaded these giant tenders weigh 395,000 pounds apiece, or as much as a large locomotive. This enormous weight is carried by two six-wheel trucks fitted with roller bearings, so the locomotive's pulling capacity will not be reduced.

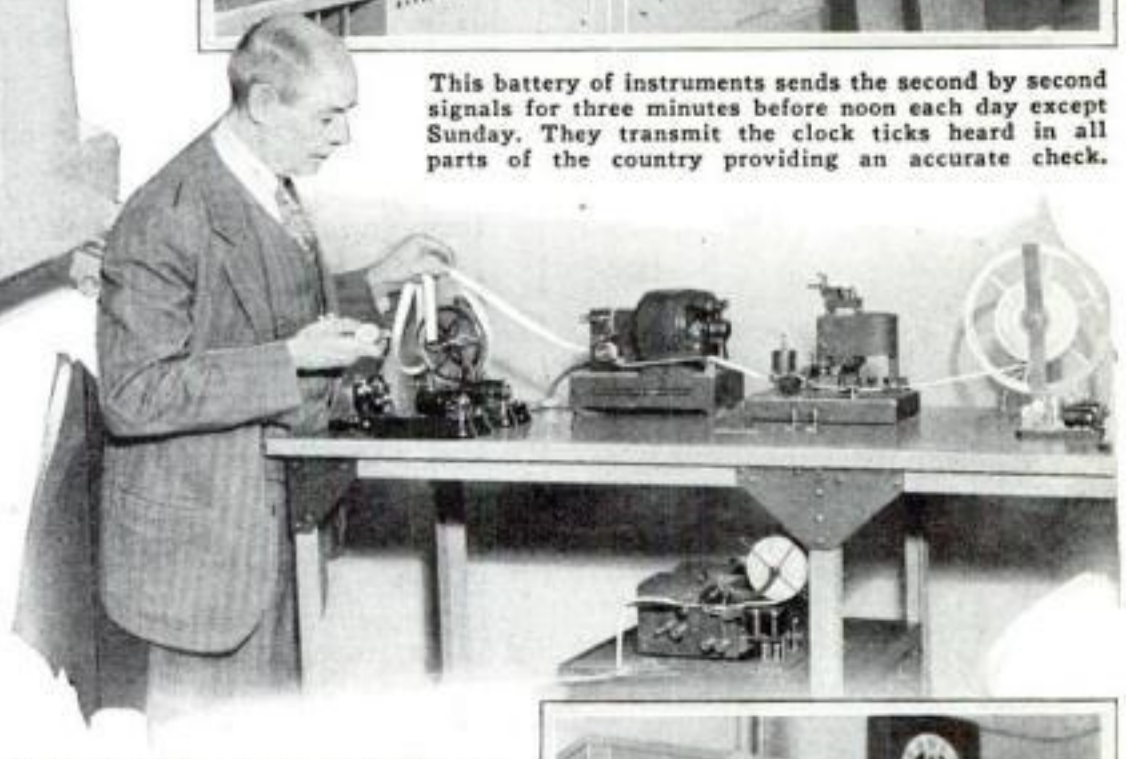
One of the two biggest locomotive tenders in the world as it looks when hooked onto the engine. The tender is over fifty-five feet long, and weighs, loaded, 395,000 pounds with a capacity of 25,000 gallons of water, more than some swimming pools hold.

Keeping Clocks RIGHT *by* Wire

At right, a master clock in Western Union Building in New York City. It is in a concrete base mounted on delicate springs. On table behind attendant can be seen telegraph instruments that repeat ticking of Washington master clock.



This battery of instruments sends the second by second signals for three minutes before noon each day except Sunday. They transmit the clock ticks heard in all parts of the country providing an accurate check.



Above, instrument that compares ticking of Washington clocks with those in the telegraph company's New York building. Ticks of these clocks are printed side by side on movable strips of paper. Below, a close-up of the automatic testing machine that insures constant service to company's subscribers throughout the nation.

On this board the synchronizing and testing machines are mounted. On the attendant's left is the synchronizing device, which, day after day, automatically winds and sets all the clocks on the circuit. At upper left is milliammeter used in making a test.

NEW apparatus, of almost human intelligence, aids in transmitting the Western Union Telegraph Company's time service to subscribers in all parts of the country. Improved synchronizing and testing machines have recently been installed in the telegraph company's new building in New York City. Time reports go out electrically from the New York master clocks to other master clocks in all the larger cities. Thence they are distributed to subscribers by branch lines. In other parts of the New York building are electrical devices that automatically wind and set at regular intervals the 120,000 clocks of the system.

From the U. S. Naval Observatory at Washington, D. C., comes the time to the New York office. Astronomical observations, made nightly if the weather permits, are used to set Uncle Sam's official clocks, the ticking of which is picked up electrically and relayed 227 miles to New York. There the ticks of the Washington and New York master clocks are printed side by side on a narrow strip of paper. Thus if the New York clocks vary from Washington time, the error is immediately noticed and corrected.

It is three minutes to twelve, noon, Eastern Standard Time. The remaining seconds before the hour can be heard being ticked off in every master clock office and many telegraph offices in the nation. This three-minute second-beat service insures the accurate testing of the local master clocks and allows trainmen or telegraph operators time to set their watches.

In every master clock office is a small contrivance inclosed in a glass case less than a foot square. This is the synchronizer, a little machine that watches the clocks of a nation. Promptly at the tick of the second marking the hour, flashed by wire from the New York office, each of these machines send electrical impulses over the wires to all the subscribers' clocks. Each clock has an electric motor attachment, and when the hourly flash comes, the motors wind and set them.

Standing next to the synchronizing machines, in each master clock office, is another new device which insures unbroken time service throughout the country. This is a testing machine, that tries out each individual clock circuit at regular intervals. It is entirely automatic and works without human attention. If this little tester finds a defective circuit, it prints that circuit's number on a moving tape, so repairmen know exactly where to look for the trouble.

Can You Tell Fog from Haze?

Terms Used by Weather Man May Confuse You but This Article Tells Their Exact Meaning

By W. J. HUMPHREYS

On observation towers like this constant records of the weather are kept and sent to forecaster.

FLYING into a thick haze one morning, an airplane pilot was astonished to notice that he could see better with his new amber goggles than without them. A few days later, flying through a similar haze, he was amazed to find that his goggles actually obscured his vision.

The fault was not with the goggles, the pilot's vision, or his imagination. It really lay with his understanding of weather terms.

His haze the first day was made up of minute particles of dust, smoke, and other organic matter that diffuses light, especially the blue or short-wave rays that may be counteracted by amber goggles. The second day, he was in a true fog.

Haze, fog, visibility, cyclone, tornado, blizzard, sleet, drought, light of the moon, dark of the moon—what are they? Not only are we nearly always vague when speaking about the weather as a whole but also, as a rule, equally inexact when speaking of any phase of it.

Fog and haze, for example, are mixed up scandalously. Often they are used as synonymous terms. Or, we may talk as though a fog were just a dense haze.

A true fog is a cloud of water droplets immediately above the surface of the earth; in other words, it is a cloud on the earth. A haze is a light cloud of dust, such as sand caught up by desert winds, the smoke of forest fires, pollen from pine-clad mountains, or the smoke, dust, and grime of great cities.

Haze commonly extends down to the surface of the earth, but it does not always do so. Sometimes its upper surface is as sharply limited and as clearly visible in the direction of the horizon as is that of a waveless ocean.

In fog the droplets are so large that they reflect equally, or nearly so, lights of all colors. Therefore, fog appears white and thick. In haze, on the other hand, a large portion of the particles are so small that they scarcely reflect light at all, but just diffuse or scatter it.

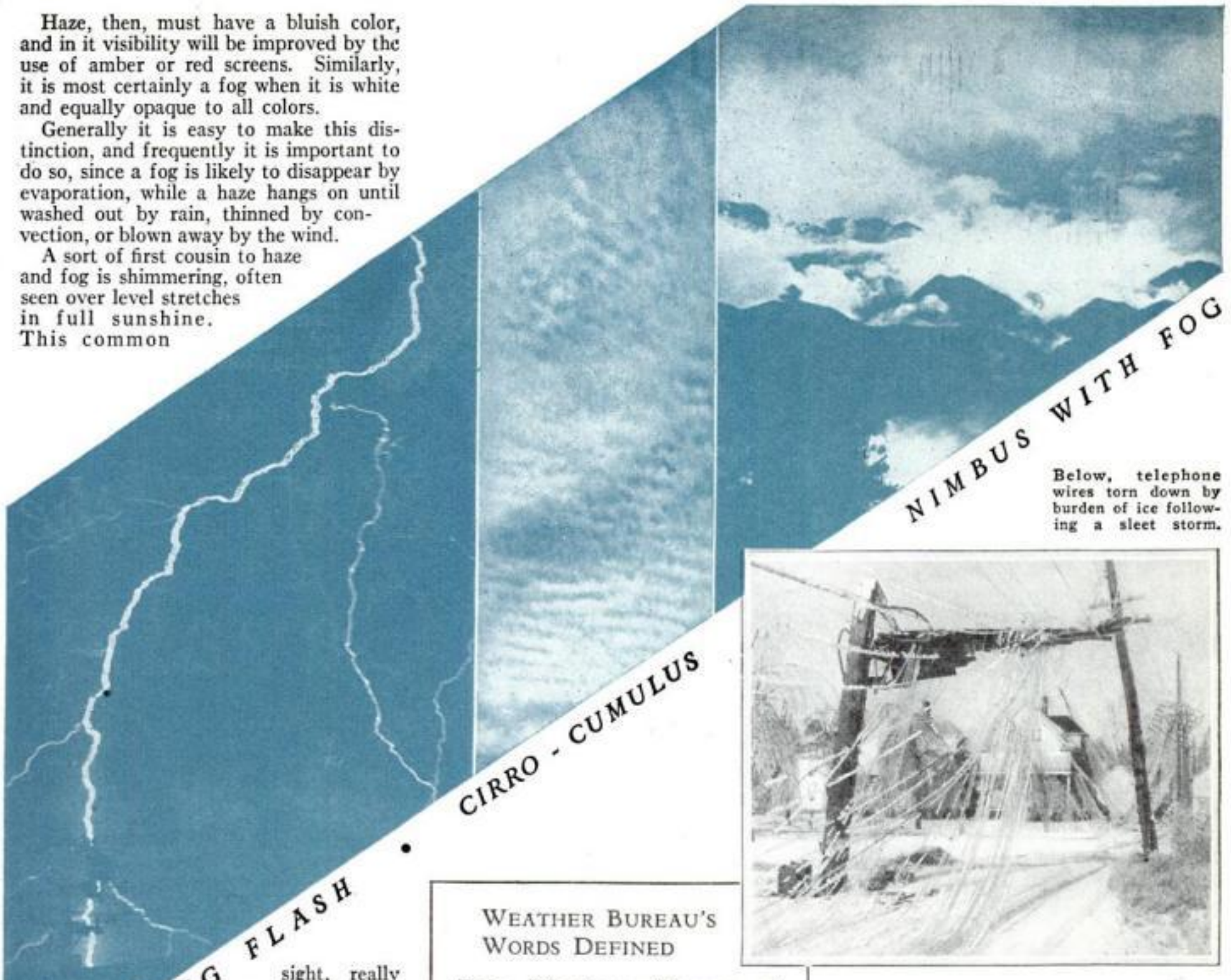
MOST important of all is the fact that they diffuse, or scatter, the blue (short wave length) light to a far greater extent than they do the longer wave length, or red, light. This causes the glare that is produced by true haze, and which can be eliminated by the use of amber or red glasses.

Dr. W. J. Humphreys, Meteorological Physicist of the United States Weather Bureau.

Haze, then, must have a bluish color, and in it visibility will be improved by the use of amber or red screens. Similarly, it is most certainly a fog when it is white and equally opaque to all colors.

Generally it is easy to make this distinction, and frequently it is important to do so, since a fog is likely to disappear by evaporation, while a haze hangs on until washed out by rain, thinned by convection, or blown away by the wind.

A sort of first cousin to haze and fog is shimmering, often seen over level stretches in full sunshine. This common sight, really a miniature mirage due to irregular refraction by commingling masses of air of unequal density, often is called haze. It has, though, no more relation to true dust haze than haze has to fog.



Below, telephone wires torn down by burden of ice following a sleet storm.

We use glibly a somewhat new weather term—visibility. This word has an obvious meaning until we try so to define it that one visibility can be compared numerically with another. There the trouble begins, for who can say how many times one object is more or less visible than another?

FOR practical purposes, the most satisfactory definition is this: the greatest distance at which objects can be seen or, better still, the greatest distance at which objects of appropriate size can be recognized by unaided vision.

Visibility may be the subject of much misunderstanding, as there may be day visibility and night visibility. Day visibility, strangely enough, is limited not by too little light, but by too much light!

Day visibility depends upon this: When the fog or haze between the observer and distant objects reflects or scatters so much light from the sun, or other sources, that the contrasts by which objects are commonly recognized are lost, visibility has reached its minimum. If any weather condition makes it impossible to recognize the outlines of a familiar figure at more than one hundred yards, you may say that the "visibility" is one hundred yards. At night, however, it is a different matter.

Then minimum visibility may depend upon the greatest amount of light that can be thrown on an object. In other words, night visibility may be defined as the greatest distance at which a light may be seen by a normal, unaided eye. One important distinction is this: The brighter the light at night the better the visibility. The brighter the daytime, the poorer the visibility is likely to be.

Weather Bureau's Words Defined

Fair Weather—Absence of rain.

Foggy—Objects hidden 1,000 feet away.

Cloudy—About four fifths sky obscured.

Clear—Not more than one third of sky obscured.

Rain—Any kind of precipitation.

Excessive Rain—Two and a half inches in 24 hours.

Light Frost—Destroys only tender plants.

Killing Frost—Destroys all vegetables.

Drought—A dry spell long enough to injure plants.

NOT only is fog often confused with haze, but frequently it is confounded with cloud. We say that fog is a surface cloud. But when the under portion disappears as frequently happens to sea fog when it drifts in over land, what shall we call the part that is left? Of all the terms in constant usage, stratus cloud seems to be the best, for that is what the fog has now become.

More confusion in the use of weather terms arises when the names of clouds are used. Back in 1803, the English chemist, Luke Howard, gave Latin names to several distinct forms of cloud, and did it so aptly that the names he proposed soon came into general use. Later on, other names were added until each of the common varieties of clouds had a distinct designation. But when, under changing conditions, new cloud pictures were needed, an opportunity was afforded to revise cloud names and definitions.

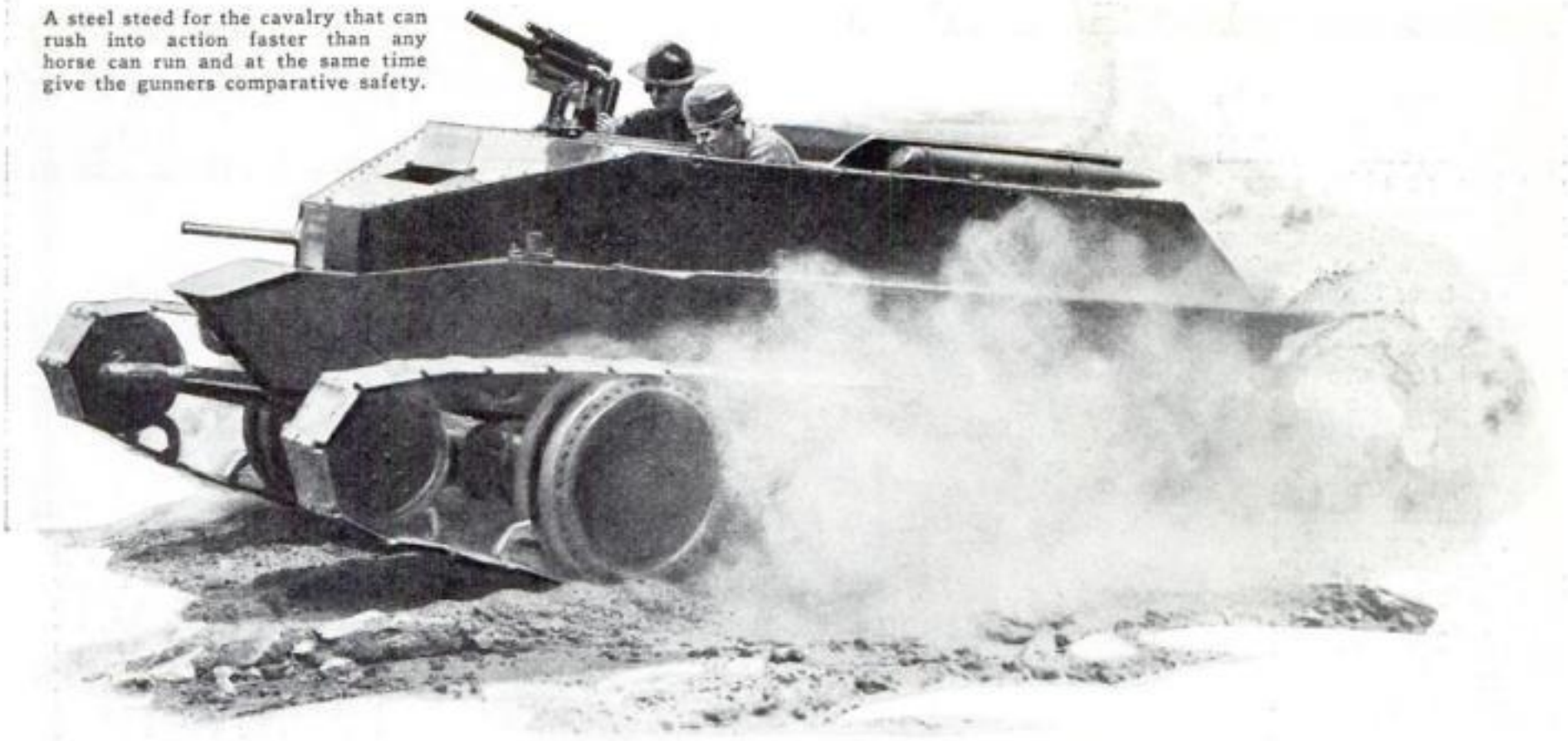
A committee, appointed for that purpose, at once began throwing monkey wrenches into the erstwhile smooth running cloud machine.

We used to be quite sure, for instance, that a nimbus cloud was one from which rain or snow (Continued on page 116)

PICTURES on these pages tell more vividly than words of the impending passing of the United States Army's most romantic arm—the mounted cavalry. Horses are too slow for modern warfare, says the Army's Chief of Staff. Except for maneuvers "in some cases of especially difficult terrain," they will be replaced by fast tanks, as shown on the opposite page. Even the sturdy horses that drag the artillery's fieldpieces into action will give way to motor tractors. The contrast between war of the past and future is visualized in these striking photographs.

EXIT the Cavalry

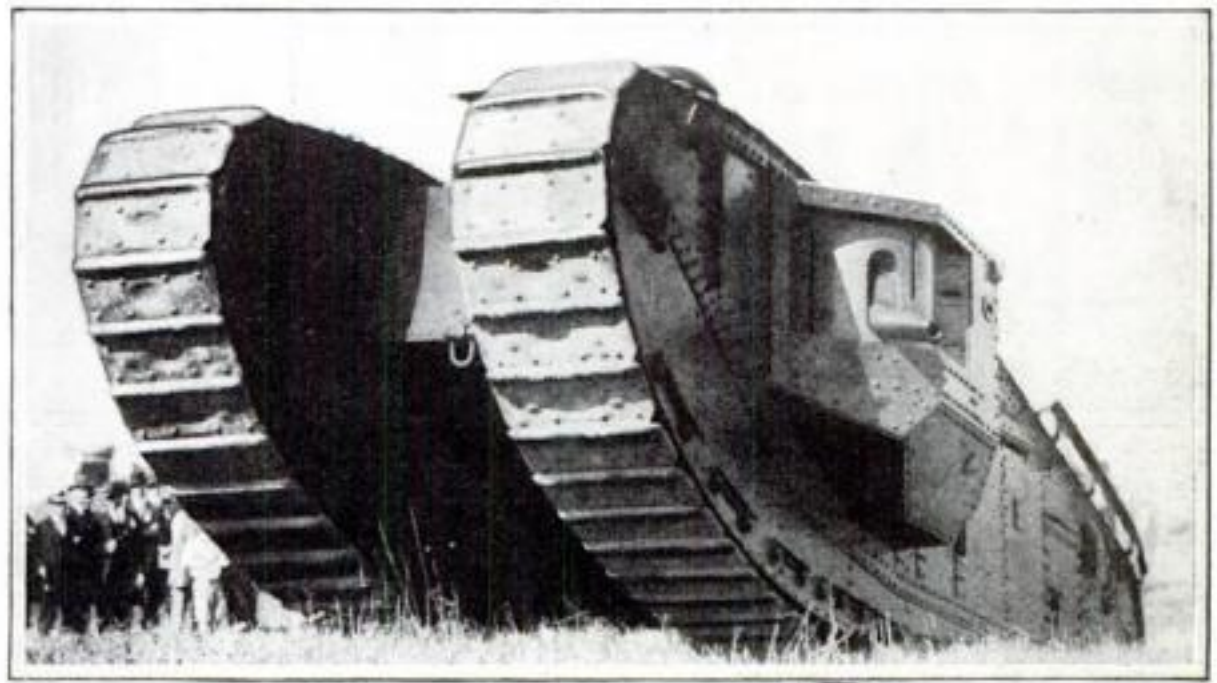
At top, the caissons go rolling along to the thunder of hooves, but these powerful horses will soon vanish from the artillery. Center, left, cavalry of Fort Sam Houston, Texas, seen on difficult terrain where it would be impossible to use the tanks that are to replace the horses. Center, a mounted troop winding its way up the side of a mountain defile. Such scenes will soon be only a memory. At right, a cavalry charge, one of the most thrilling actions in military maneuvers. Soon it will give place to roar of motors as tanks attack.



A steel steed for the cavalry that can rush into action faster than any horse can run and at the same time give the gunners comparative safety.

. . . *ENTER the* Tanks

A PROGRAM through which the United States Army plans to replace as many as practicable of its 8,000 horses with fast tanks has just been announced by General Douglas MacArthur, Army Chief of Staff. One regiment of "mechanized cavalry" is to be organized immediately; others are expected to follow soon. Newly-invented tanks can scoot across country with men and guns at more than a mile a minute. Wherever the country is not too rough cavalrymen of the future will ride these gasoline steeds into battle. Tanks attached to the cavalry will be called "combat cars."



Center, a giant tank, snapped in action as it roared along during the Army's first experiments with its "Gasoline Brigade." Above, a file of cavalry of the future as it may rush across country at high speed to strike swiftly at the enemy. At left, a big gun mounted on a tank that is capable of carrying it into position in an incredibly short time. It probably is in this way that the big cannon will, in the future, be hurried to the most desirable point for the attack.

PLANE GETS FLASHLIGHT OF CITY

NEW YORK posed for its flashlight picture recently. Army flyers, soaring over the city late at night, demonstrated one of the newest wrinkles in aerial photography by dropping a huge flashlight bomb of three billion candlepower from the air. The remarkable photograph reproduced here was the result. Since the first flashlight pictures were taken from the air some time ago, the technique of this unusual branch of aerial photography has been greatly improved. The latest camera used for the purpose is set off automatically just as the flash is at its height, by the concussion of the exploding bomb. The projectile is timed to go off at a safe distance from the plane that drops it.

Above, a flashlight picture of New York made from the air with the use of three billion candlepower bomb which, exploding automatically, operates a camera at exactly the right instant. At left, pilot with flashlight bombs under wing ready to ascend for a night picture.

COMB AIR FOR WHEAT SPORES

ROARING through the air in a plane at a speed of one hundred miles an hour, plant disease specialists of the United States Department of Agriculture literally comb the ether for spores of black stem rust, a disease that causes an annual loss of many millions to wheat farmers. Microscopic slides, greased with vaseline to make the tiny spores adhere to them, are exposed at various altitudes to learn how far and how fast the germs of this plant disease travel from infected wheat fields. When a slide has been exposed, it is placed in a bottle and tightly corked so that the scientist can make an accurate count of the spores combed from the air. The photograph above shows the Government plant disease experts about to take off on their aerial spore hunt; to its right are exposed slides in bottles.

CARRIERS MARKED TO HELP PILOTS

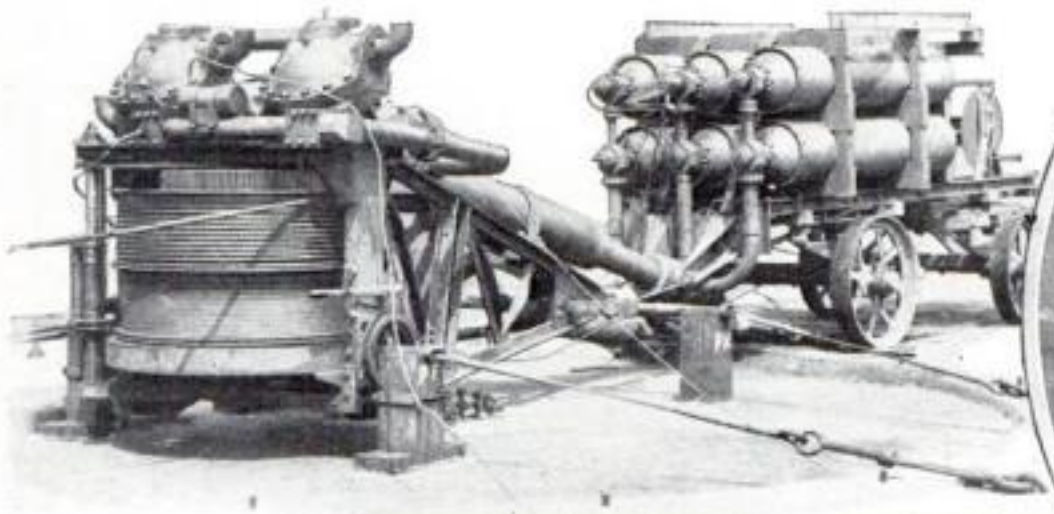
UNCLE SAM'S big aircraft carriers *Lexington* and *Saratoga* recently had distinguishing marks painted on their funnels so pilots can identify them from the air. The *Lexington* funnel was given a broad black horizontal band while the *Saratoga* was given a vertical black stripe.

Below, aircraft carrier *Saratoga*, with black stripe painted on her funnel. In circle, *Lexington* with black band.

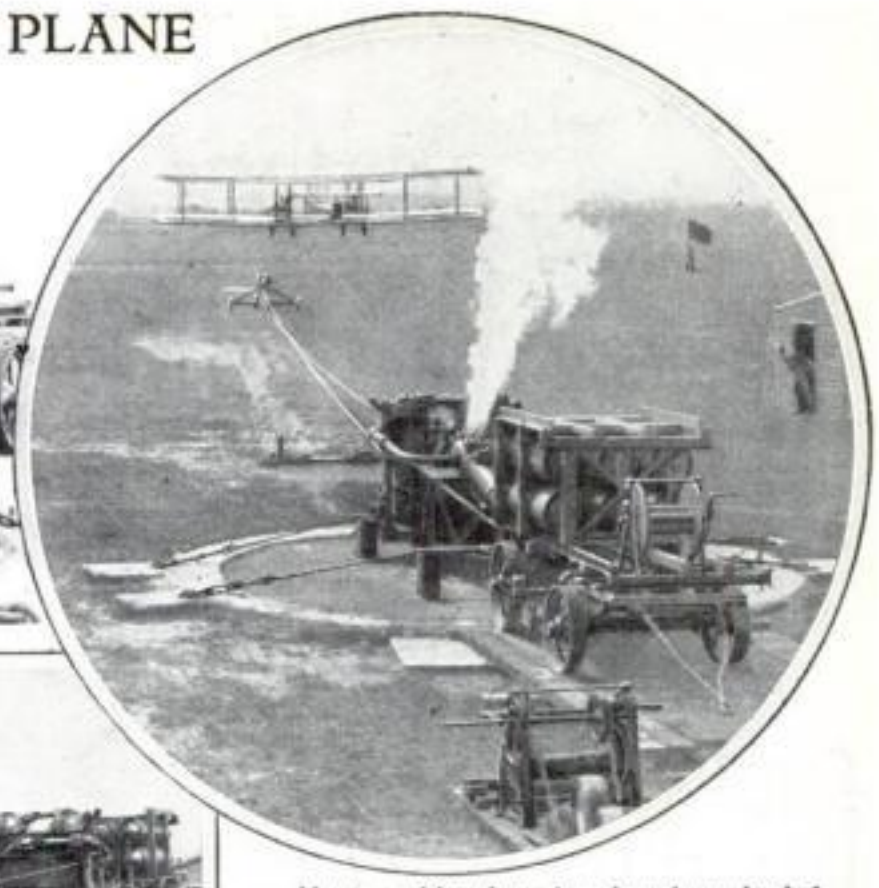
SMASH LANDING GEAR IN FACTORY TEST

ACCIDENTS are made to order in airplane manufacturing plants so that pilots and passengers may safely trust their lives to new models of planes. At the plant of a Burbank, Calif., aircraft builder, landing gears for new designs are given a heavy load of sandbags and then dropped from heights of several feet. After the sandbags have been removed from the wreckage, plane designers study the broken parts in an effort to see how they can be strengthened before being applied to planes in daily use.

CATAPULT LAUNCHES NINE-TON PLANE



Above, a 4,000-horsepower compressed air catapult, only one of the kind in the world. At right, catapult dolly beneath the tail of the nine-ton bomber.

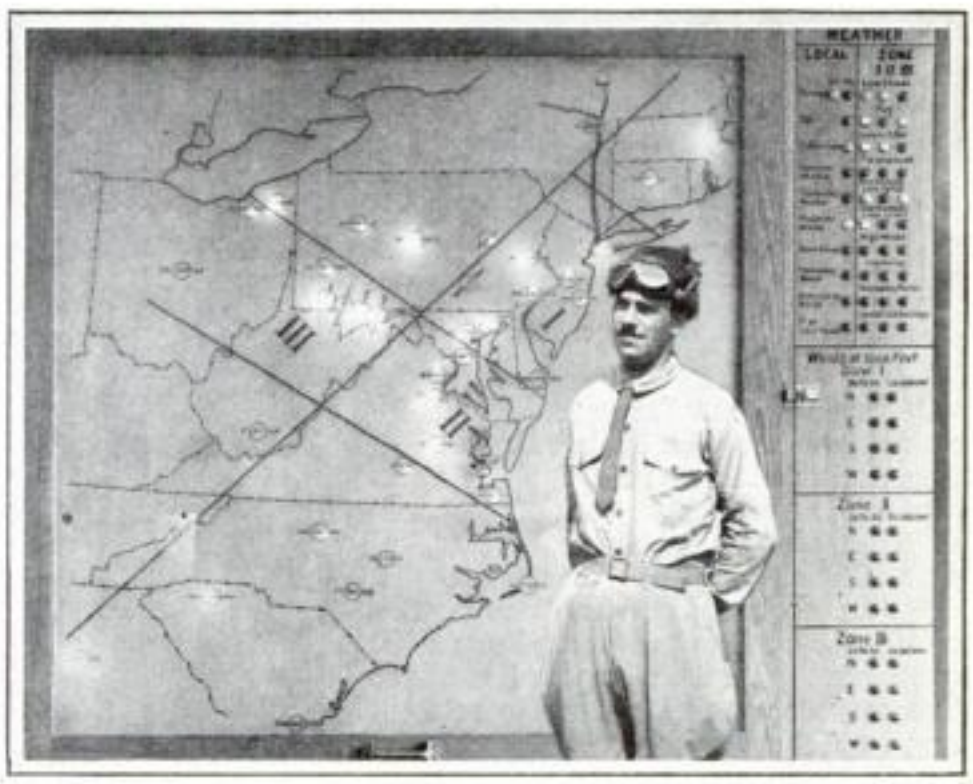


Above, a big plane has just been hurled into the air at Farnborough, England, by compressed air catapult in foreground; the dolly is in the background. What looks like smoke in photo is atmospheric moisture condensed by chilling air exhaust.

LAUNCHING a nine-ton bombing plane with a catapult seems almost as incongruous as firing a twelve-inch shell from a pea-shooter. Yet that is the extraordinary feat accomplished by the mightiest of all catapults, recently demonstrated at Farnborough, England. Officers of the Royal Air Force watched this 4,000-horsepower compressed air engine, the only one of its kind in the world, hurl a twin-engined night bomber into the air with a run of only thirty yards. Under its own power, such a plane could leave the ground only after a 300-yard spurt, necessitating a long and well-kept runway. In the new device a wheeled "dolly" runs on an endless cable between the machine and an anchored pulley in the middle of the field, and boosts a plane into the air by its tail. Military experts consider the new "land catapult" of great tactical importance, since it will enable big bombers to take off from air fields of limited size, thus increasing their mobility. The Royal Air Force has been pioneering for some time with its catapult experiments on land, hitherto used extensively only on ships.

LIGHTS ON MAP WARN FLYERS

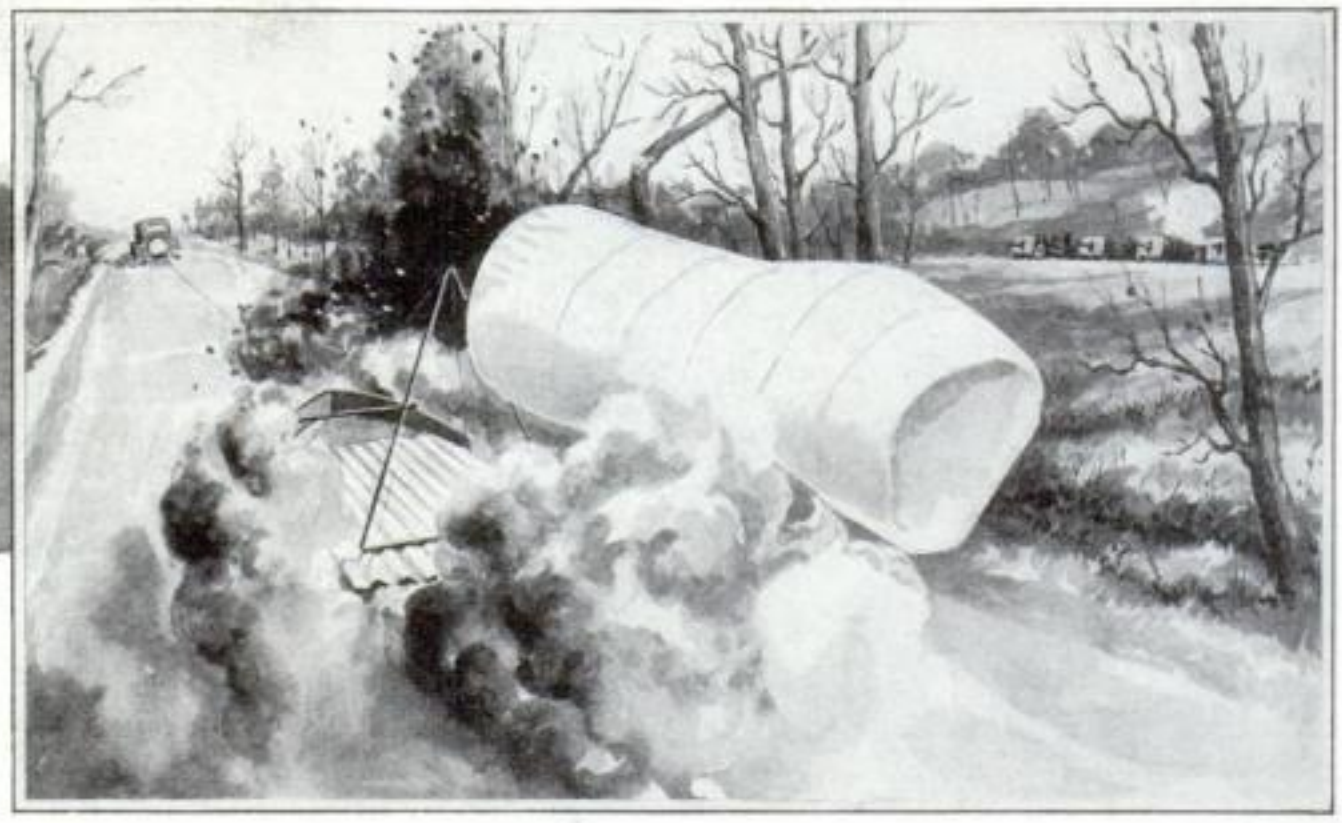
TINY colored lights on a big wall map at the Naval Air Station, Anacostia, D. C., show aviators what the weather is like over the entire central eastern part of the United States. White lights indicate good flying weather; green lights, poor flying conditions; and red lights show them that the weather is bad. Since these lights are scattered over a wide area on the map, they give the flyer instantly a complete picture of the weather. At one side of the map is a narrow panel on which different combinations of colored lights give a more detailed picture of weather conditions than are shown on the big map. These warn the flyer of fogs, high winds, poor visibility, and rain. As the weather reports come in by wire, radio, telephone, and teletype, the little lights on the board flick on or off. After a report is two hours old its light on the map is turned off. Should any dangerous change in the weather occur, it is called to the attention of flyers by means of a bell signal on the map.



WINDMILL VANES ON GLIDER

THE first glider fitted with windmill vanes, made familiar by autogiros, appeared at a German airport the other day. On a vertical post before the pilot's cockpit the vanes, like a big four-bladed propeller laid horizontal, were mounted. The glider's wings were slightly smaller than those of an ordinary motorless plane. The vanes enable this glider to stay aloft in lighter winds than are required to support ordinary craft of this type. They will also enable the glider to move through the air more slowly than other gliders. The odd little 150-pound craft on which the windmill vanes were tried in Germany was also fitted with a radio set, by means of which its pilot kept in touch with the ground while in flight.

ARMY TRIES GUNS ON FAST-MOVING TARGETS



Above, the new artillery target for the Army attached to the metal sled behind which it is towed at speeds as high as forty miles an hour. At right, drawing shows target with shells bursting near it. Note in distance the fast towing auto.

MECHANIZING armies has so greatly speeded up land warfare that field artillerymen now have to learn to shoot, as do naval gunners, at rapidly-moving targets, with their fire controlled by observers in airplanes high overhead. Preparing for the day when they may be pitted against fast-moving tanks and armored cars, United States Army gunners at Fort Bragg, N. C., have been practicing their gunnery on new-style targets traveling at speeds as high as forty miles an hour.

A sheet-iron sled or toboggan is towed over the ground at the end of a long tow-line behind an auto. From a framework on the sled a sleeve-shaped streamer is flown clear of the ground, flaring out in the breeze as it is towed along. The illustration above shows the target in use, with a shell exploding in front of it.

This is the mark on which the gunners try to lay their pieces under the direction of airplane observers. As the towing car drags the target over the ground, it swerves and changes direction. Thus it imitates the actions of a hostile armored car in its attempts to throw the gunners off their aim.

This is not the first time the Army has used moving targets in its artillery practice, but in the past these targets were never moved at a speed in excess of ten miles an hour. Faster machines make faster targets necessary.

NEW HACK SAW FRAME GIVES TAUT BLADE

This new hack saw has a shallow frame that permits its use on work in restricted space.

A NEW hack saw frame is designed for making shallow cuts such as in cutting the metal sheathing on BX cable or working in close quarters. Instead of the familiar deep "D"-shaped frame of standard saws, this one has a shallow frame that fits closely along the blade's top. This enables the blade to be stretched somewhat more tightly than in standard saws, so that only one hand is needed to hold the saw, as shown in the photo above.

BEES GO 40,000 MILES FOR ONE POUND OF HONEY

WOULD you go more than one and a half times around the world for a pound of honey? According to bee experts, a bee travels about that distance in making a pound of honey. Bees that were watched made about 10,000 round trips of two miles each to gather enough nectar to make half a pound of honey. Since this material loses about half its weight through evaporation, twice that number of journeys had to be made before the bees had a pound of honey.

THIS HOUSE IS AN OPTICAL ILLUSION

FAMILIAR to many are the fake houses used on movie lots, where only the front is needed for a scene. A clever Pennsylvania real estate man adopted the same idea recently.

Approaching motorists see what, apparently, is a full-sized, attractive Colonial dwelling. As they pass, however, the deception is revealed.

The "house" is a wall of stone and clapboard with a flagged walk and a well-kept lawn.

Above, the picture certainly looks like a well-built house, but it merely is an illusion as the "house" consists only of a front, fully finished with a walk and lawn. At right, the illusion is destroyed as view shows the "house" is without depth. It is used as an ad by a Pennsylvania contractor.

Buying the PARTS for Your Television Receiver

By GEORGE H. WALTZ, Jr.

LAST month George Waltz related how he first became interested in television when he heard the peculiar buzz-saw signals of vision transmission on a short wave receiver. Later he visited one of New York City's sight broadcasting stations and was so fascinated by what he saw that he decided to build a television receiver. In this article he takes you with him on a shopping tour, telling you all you will want to know about what is available in television equipment—kits, parts, and complete receivers—what they cost and how they are used.

The clerk showed me an undrilled scanning disk and explained, "Most of the amateurs want to drill their own."

"I WANT to see some parts for television receivers," I told the clerk in the radio store.

"O. K.," he replied, "but why build a set when you can buy one already assembled and ready for use? Here's one that costs only $150 complete. You couldn't do much better than that if you assembled the parts yourself. If you can wait about ten minutes we'll show you the set in operation."

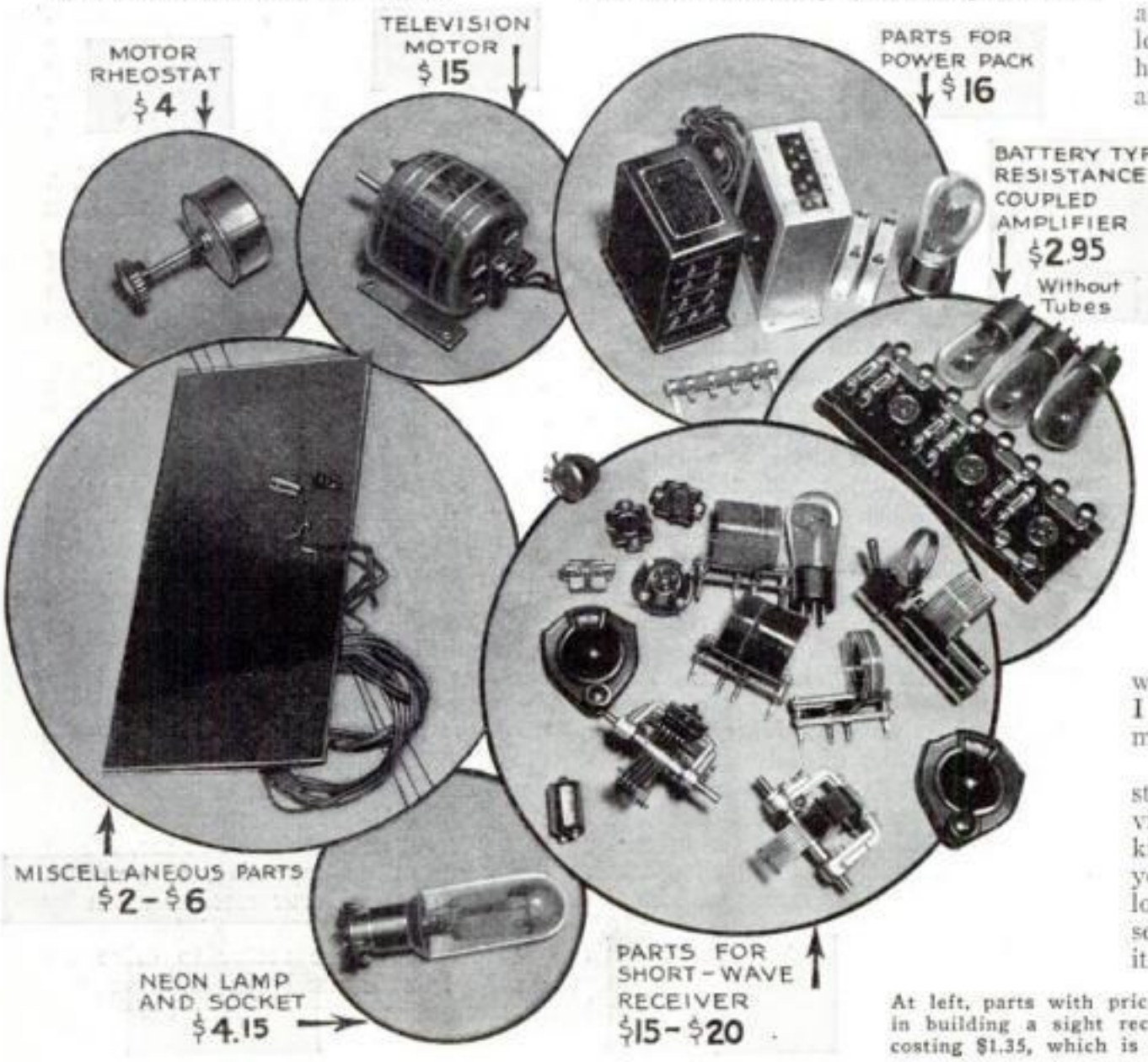
"What station is on the air then?" I asked as I inspected the assembled set.

"Oh," the clerk said, "we don't receive any station. You see this isn't a good location for short wave reception so we have a film-pick-up device in the store and we wire it direct to the receiver."

While the clerk threaded the film in the transmitter—an apparatus that resembled a motion picture projector—a crowd gathered around the receiver, eager to see the television demonstration.

As the final adjustments were made a faint pink glow appeared on the lens of the receiver. Unlike the demonstration I had seen at station W2XCR, which I described last month, this faint glow continued, and, as far as I could make out, never did grow into an image. Instead, black spots streaked back and forth across the lens like the specks seen by a man whose liver is out of order. If this was a sample of the "vision" you got with this particular factory built receiver working under apparently ideal conditions I decided that I wanted to buy another make or build my own.

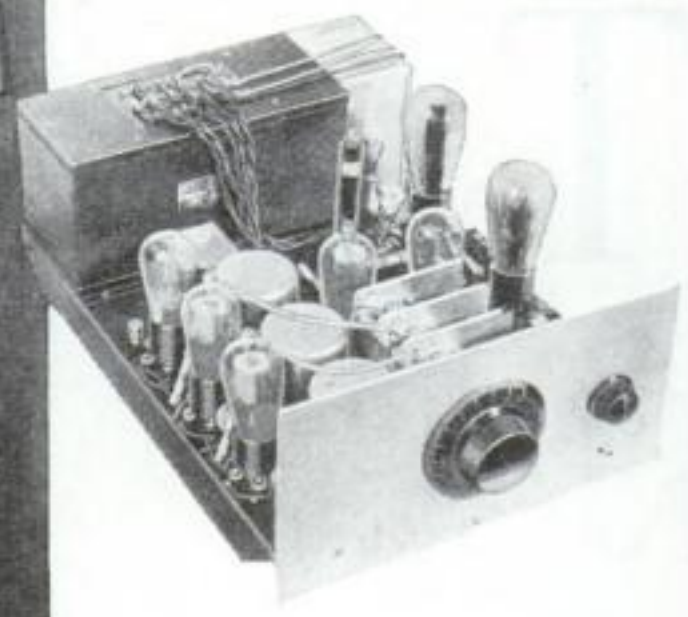
"Not so hot, eh?" commented a man standing beside me. "I'm building a television set myself. I bought a complete kit for $120. You get all the parts that you need and you assemble them by following simple diagrams. It's a cinch. I've seen a set made from a kit like mine, and it really gives a 'vision.' Interested?"

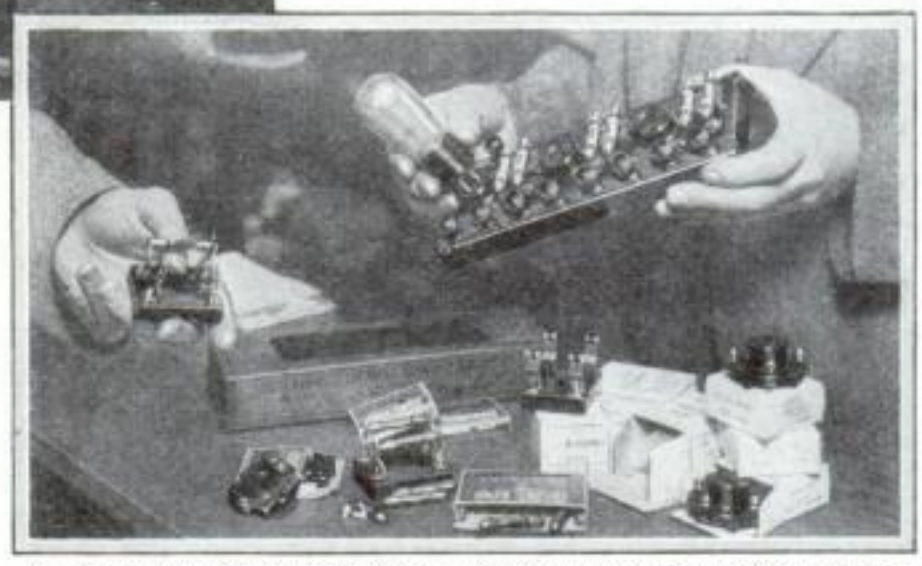


At left, parts with prices attached that are needed in building a sight receiver, except scanning disk costing $1.35, which is shown at top of this page.

Summer fashions being broadcast from a station in New York. On each side of the performers are photo-electric cell banks.

Below, a short wave television receiver and amplifier built from parts contained in a commercial kit.





At right above is an assembled resistance coupled amplifier costing $2.95. On the counter are parts needed to build it, costing $4.20.

"Well," I said, glad of the opportunity to talk to a kindred soul, "I haven't built a set yet; in fact, I haven't even bought the parts. I'm shopping around in the radio stores trying to get an idea of the parts I'll need and picking up hints on how to get started."

"The company that puts out the kit I bought," my chance acquaintance continued, "sells a larger kit for $214.50 and four types of factory built sets ranging from $169 to $335. The $214.50 kit contains a self-synchronizing device."

"What is a self-synchronizing device?" I asked, somewhat puzzled.

"It's an apparatus that keeps the variable speed motor that drives your scanning disk in synchronism with the disk on the transmitter," he replied. "You know, unless the disk on the receiver is turning at just the same speed as the transmitting disk and is in step with the transmitting disk, you can't receive an image. With one of these self-synchronizers, you just bring your disk up to the speed of the transmitter and the synchronizer does the rest."

"Why can't you use a synchronous motor?" I asked.

"A synchronous motor is fine," was the reply, "if you receive your power from the same power house that supplies the motor on the transmitter. Most of the kits supply a variable speed motor and a self-synchronizer. Of course, you can use a variable speed motor and keep it in step by slowing up the disk with a little judiciously applied thumb pressure."

"Then if I want to receive stations outside of New York City I'll have to provide some sort of synchronizing device. Are they very expensive?"

"No," he said, "and besides you can buy them along with all the other parts you need for your receiver in the five cent, ten cent, and dollar stores now. I happened to find that out when I needed a few connecting lugs the other day. I went to a chain store in my neighborhood and right next to the radio parts was another counter with television parts. You can get everything you need there and I think the entire list of parts for a receiver only comes to about $110, including the tubes. Pretty cheap, don't you think?"

As I walked from the store I consulted my list for the next store I had planned to visit and headed in that direction.

"Sure we sell television parts," the clerk said. "Just what do you want?"

"That," I replied, "is what I would like to know. What do I need?"

The clerk reached behind the counter and brought out a catalogue of parts. As he thumbed through the pages he said, "To start with, you'll need a resistance coupled amplifier. For television a three-stage amplifier ought to hold you. Now let's see. We can supply one for $2.95."

"How much would it cost if I bought all of the parts and assembled it myself?" I asked, anxious to save money in any way that I could.

"For each stage of resistance coupled amplification you'll need two coupling resistances, costing about thirty cents each; a socket, costing twenty cents; and a coupling condenser, costing sixty cents. That's $1.40 for each stage or a total for the three stages of $4.20. It's really cheaper to buy one already assembled."

"How about the parts for the short wave receiver," I asked. "How much do they cost?"

"Most short wave receivers," the clerk explained, "consist of a tuning arrangement and a detector unit. For television I would suggest two variable condensers costing about $3 each and a detector unit that you can build for about sixty cents. The complete receiver, figuring $7 for the coils, shouldn't cost you much over $14."

"Besides the scanning mechanism, that's all I'll need then," I interrupted.

"No," the clerk replied, smiling, "you'll need some sort of power supply for the tubes in your set, just as in a regular radio. Figuring about $6 for the power transformer, $2 for the resistances, twenty cents for a socket, and $6 for filter condensers, the power pack, as it is called, should cost about $14.20 complete."

"Well then," I figured, "the amplifier, short wave receiver, and power pack should cost me approximately $28."

"That's right," the clerk replied. "Of course, if you want to take a chance on replacement parts you may be able to cut that price some."

"Do you sell scanning disks?" I asked, feeling a little more confident of what I was talking about.

"Yes, we have two kinds in stock." He put two metal disks on the counter. "One, made of aluminum, costs $1.35, and the other, of duralumin, costs $1.50. Each is twelve inches in diameter and as you can see is undrilled. We sell the disks undrilled because most amateurs would rather drill their own."

"Then," I said, "I'll have to drill the disk myself?"

"Not necessarily. You can buy disks already drilled if you prefer. But I don't think you'll find it difficult to drill your own. The most important thing is to lay it out accurately. You see, drilled disks are rather expensive, so you can keep the cost of your receiver down by drilling your own."

"How about the motor to drive the disk? I understand that I have two choices," I said, remembering what I had been told about *(Continued on page 115)*

Last living Cape Bushman, blind and deaf and said to be 107 years old. He is hardly able to stand.

At left, two South African Bushmen with tiny bows and poisoned arrows. Behind them is a cave, its walls bearing their paintings.

Century-Old Man *is Only Survivor of* Stone Age Race

By F. W. FITZSIMONS, F.Z.S.

Director Port Elizabeth, South Africa, Museum

NOT long ago I discovered a century-old native, believed to be the last of the Cape Bushmen who inhabited South Africa as far back as the Stone Age. My Cape Bushman is 107 years old, blind, deaf, and barely able to stand. He can, however, still enjoy a pipeful of tobacco. This man's ancestors, it is believed, were the cave dwelling hunters who immortalized themselves in their paintings on the cave walls. The men of his race averaged about four feet eight inches in height and the women about four feet.

These were the people who fought and loved and ruled in the southern part of the Dark Continent perhaps 100,000 years ago, before the dawn of the white man's civilization. They lived on birds, ants, caterpillars, snails, and locusts.

When ostriches were plentiful, they added ostrich eggs to their diet. The shells they used as food containers or broke them up into small fragments which they strung into bracelets.

They were a migratory race, living a hand-to-mouth existence until larger and stronger natives swept out of the south and invaded their territory, making war on the little people. In order to offset the disadvantage of their small stature when fighting larger enemies, the Cape Bushmen started using poisoned arrows. From the first it was an unequal combat, and gradually the little people were forced to flee from their native territory, moving northward. On their way they met a southward migration of the Bantus, a large and war-like breed of men. The small Bushmen were thus like nuts between the jaws of a cracker.

As they fled still farther from their hunting grounds, a new scourge appeared at their heels. White men had just landed at what is now Cape Town, and these moved north, harrying the Bushmen with fire and sword. Then began a war of ruthless extermination of the small people. Occasionally they would sally forth from the refuge of their woods and forests on retaliatory raids of bitter hopelessness. They had no chance of success on these periodic uprisings. All the Bushmen wanted was to inflict as much damage as possible on their enemies before being sent to join their strange gods. Enraged by these forlorn forays, the whites declared the little people vermin, to be exterminated on sight.

So thoroughly was the work of extermination carried out that only once before in the course of my travels have I seen Cape Bushmen. Many years ago on a farm in the Karoo, the high tableland of interior South Africa, I saw two of them serving as herders. They were brothers, and one was over one hundred years old. He said he could distinctly remember the last of the punitive raids made by the whites against his people who were then living in the Colesberg Mountains.

A most extraordinary story was told me by the late Professor Ernest Schwarz, of the Rhodes University College. Many years ago, he said, he was engaged in survey work between the headwaters of the Orange and Zambesi Rivers. With him was a half-breed Cape Bushman guide and interpreter. Through this man's efforts Schwarz managed to make friends with a wandering remnant of a tribe of Cape Bushmen in that region and pitched his camp near theirs.

One day he noticed the strange little people flocking to a dry hollow in the ground near their camp. Following them he saw they were gathering about the remains of a gemsbuck. At a given signal they all began to eat, pausing occasionally to dance madly around the hollow. Presently the feasting stopped, but the dancing continued with unabated vigor, men and women occasionally dropping out, exhausted. When they had rested and recovered they again joined the madly dancing horde.

After some time of this Schwarz noticed a strange figure in the midst of the little people. It was a man loaded down with enormous strings of ostrich shell beads. He was given food and joined in the dance. Every one treated him with the utmost respect. The festivities continued until sunset, when a sinister and expectant hush fell over the weird assembly of little figures who had stopped their dance. In the darkness two figures crept up behind the stranger, threw a thong of softened animal hide over his neck, braced their knees in the small of his back, and strangled him! Schwarz had just witnessed a Bushman's execution.

Since these people were nomads and buried their dead at any convenient spot on their travels, there are many relics of their times scattered throughout South Africa. From time to time, as rain or the action of water washes away surface soil, Bushman graves containing weapons and tools are found beside the skeletons of their owners. These people had no knowledge of metal working and used ivory, bone, and stone for their implements.

Another type of Bushman, called the Strandlooper, lived on the seacoast of South Africa. They inhabited rock shelters and sand dunes, burying their refuse and their dead under the floors of their dwellings.

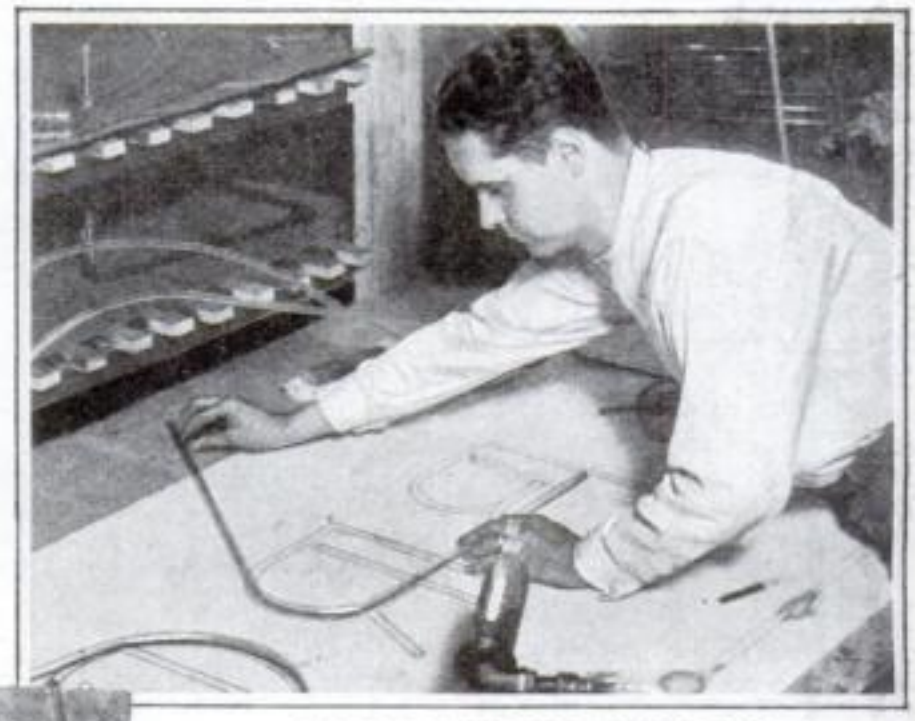
While the Cape Bushman is practically extinct, there are other races of little people in Africa that probably sprang from the same parent stock—the Pygmies of Equatorial Africa and the present Bushmen who inhabit the Kalahari Desert in South Africa.

A white man and two Bushmen. Note difference in their height.

MAGIC OF NEON SIGN MAKING SHOWN IN PICTURES

HOW NEON LIGHTS ARE MADE. The story of the strange new light, invented by Georges Claude, French engineer, told in photos.

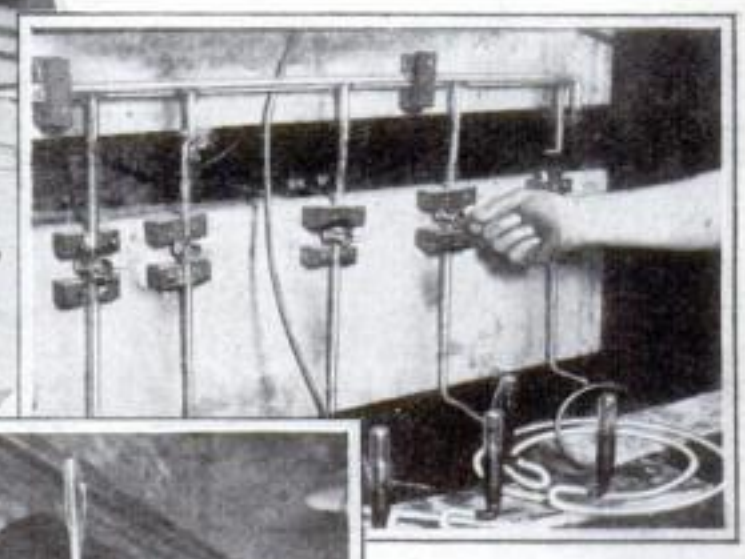
FIRST STEP IN MAKING A NEON SIGN. An artist draws a design which includes lettering and decoration, and this design is then enlarged to desired size so tubes can be right dimensions.



SHAPING THE HOT TUBES. With the artist's design laid upon sheet asbestos, the tubes for the neon sign are heated and then quickly laid in place upon the design and bent to fit it.

FUSING GLASS TUBES. Running letters of light give the advertiser's name to the world in these neon signs. Here the fusing of the glass tubes is being done after they have been shaped into letters. The flame of a blowtorch heats the edges to be joined as the workman blows through the tubing to keep the joints from clogging.

DUPLICATES YOUR WRITING. At right, a neon sign with letters shaped in exact duplication of the original writing was made in five hours. The sign, lighted for twelve hours, gave off no heat. Electrodes at top of sign are fused to the beginning and end of the tubing.

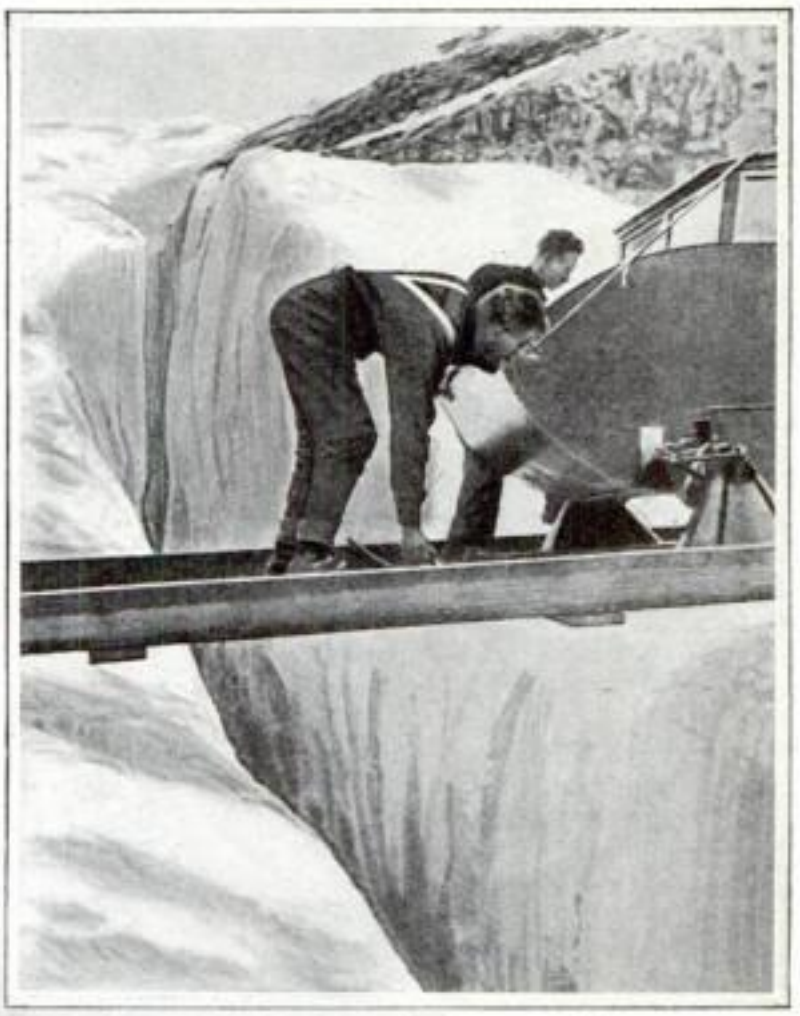


GETTING THE GAS. Above, gas, which gives the desired color, is being put into the tubes. Red is the only color that uses neon. Blue lights are the result of mercury vapor. Yellow signs use helium and other gases—green is the same as blue except the glass itself is colored amber. White light which, it is expected, will be widely used to light offices and private homes, is produced by a combination of gases, the formula for which is a trade secret.

DEATH *speeds up* *Search for* New Arctic Route

At left, one of the last photos of Prof. Alfred Wegener, leader of the German expedition in Greenland, standing beside one of the propeller sledges he took with him. His body was found recently by the members of a rescue party.

At right, hauling a propeller sledge across a crevasse in a glacier. Below, Dr. Loewe at the central Greenland station of the Wegener party. At bottom, a remarkable picture suggesting the overwhelming loneliness as night overtakes a propeller sledge on the icy desert of the far north.



TWO expeditions, one German, one British, established outposts upon the forbidding ice cap of central Greenland, last year, seeking a possible landing place for transatlantic airplanes.

Searchers with airplane and dog teams found Augustine Courtauld of the British Arctic Air Route Expedition, this spring, hungry and unshaven.

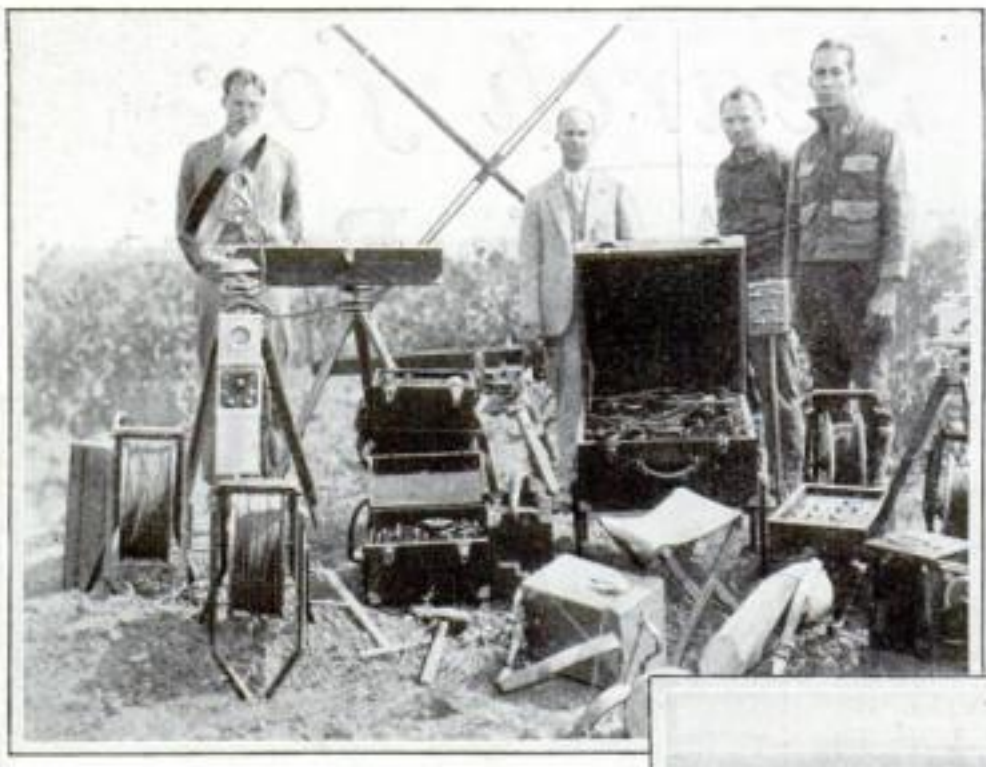
Less fortunate was Prof. Alfred Wegener, hero-leader of the German party.

To bring food to two scientists at the German central station, Wegener, Dr. Loewe, and thirteen companions started from the coast with provisions. Only by abandoning all the food did they reach the central depot last October.

There was food at the depot for only three men. Wegener and a Greenlander started back for the coast. They never reached it. A second relief expedition, a few weeks ago, found Wegener's sledge in a drift—and his body near by. Probably the Greenlander also perished.

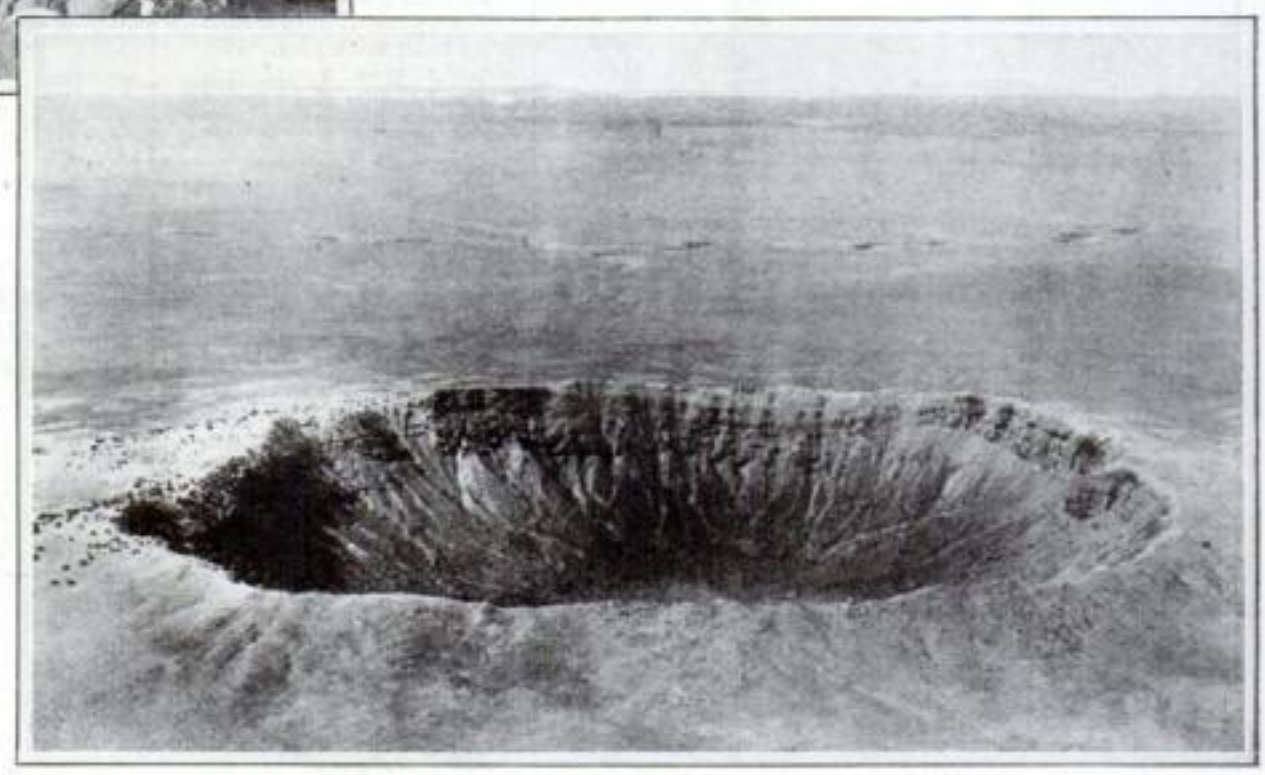
Despite the death of their leader, the little band of Germans will remain with Prof. Kurt Wegener, brother of the hero, in command. With dog teams and their two propeller-driven motor sledges, they will continue to explore the icy wastes.

Electrical Survey Solves Mystery of Meteor Crater



The men who solved the crater mystery are shown with equipment. Left to right: J. W. Daly, J. J. Jakosky, V. F. Hanson, C. E. Wilson.

Above, mine shaft on crater's edge. At 600 feet, water stopped work. Below, Meteor Crater, scooped out by meteor falling from space.



THE Mystery of Meteor Crater is apparently solved. This gigantic pit in the desert near Winslow, Ariz., big enough, if flooded, to float the whole American Navy, has been for years the subject of controversy among scientists. One camp held that an underground steam explosion caused it; the other, that it was hewed out by an enormous meteor. With the location by a recent electrical prospecting expedition of a huge mass of metallic substance below the southern end of the crater floor, it now appears that a giant meteor was responsible. This has long been suspected from the appearance of the hole—4,000 feet in diameter and 600 feet deep—with slightly upturned rim. It looked as if the greatest meteor that ever struck the earth, possibly 50,000 years ago, had bulged the edges as it buried itself with a shock that must have jarred the continent. But the meteor could not be found. Shallow exploring shafts, sunk in the crater floor, filled with water and were abandoned. Lured by a fortune in platinum and nickel that the meteor was supposed to contain, an exploring company recently sank a 650-foot shaft on the crater rim, on the theory that the meteor had plunged slantwise into the earth. It found nothing, and this shaft was also abandoned. Now a party of prospectors from Culver City, Calif., with electric equipment that locates underground metals, announces a more successful quest.

Electrical instruments were set up on the bottom of Meteor Crater, 600 feet below the surrounding country. Here traces of the meteor were discovered by the prospectors.

NEW AUTOMATIC ALARM WARNS OF EARTHQUAKE

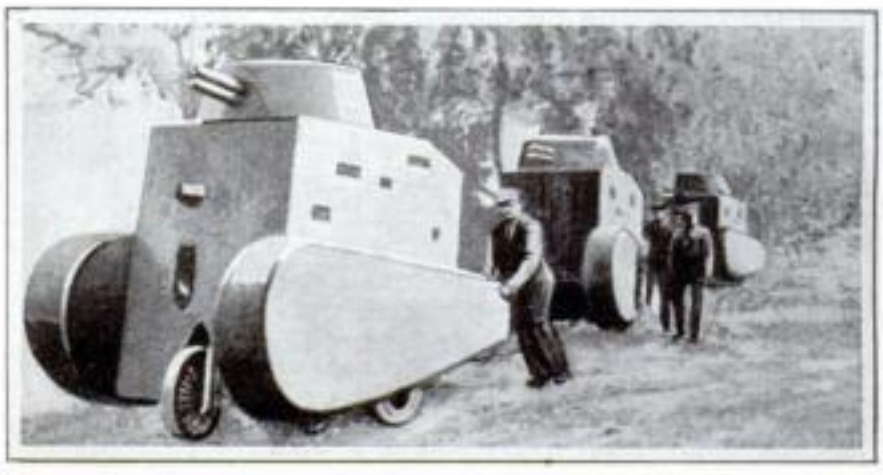
AN ARGENTINE inventor has patented a device to warn sleepers of an earthquake in time for them to dress and leave the house. At the first trembling of the earth, this invention automatically turns on all the lights in the house and rings a bell. In a public demonstration at San Juan, Argentina, the inventor caused the apparatus to function by shaking the walls with an explosion of photographic flashlight powder.

COIN-IN-SLOT MACHINE SERVES HOT DOGS

HOT dogs from a coin-in-the-slot machine were a recent innovation at a German fair. After depositing the right coin, customers turned a crank and out came hot dog, bread, and mustard on a paper plate. The frankfurters are steam-heated until the crank is turned. This drops them into a bath of hot water, cooking them. The machine holds fifty sausages at one filling.

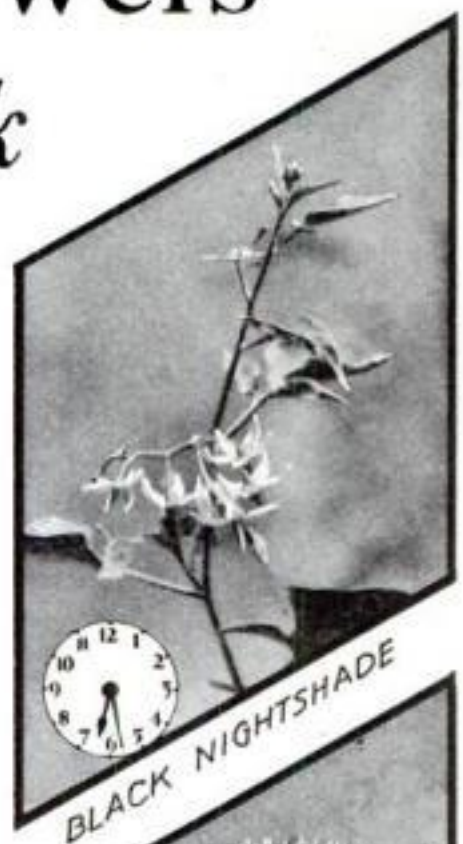
DUMMY TANKS USED BY GERMAN TROOPS

DUMMY tanks made of wood played the part of actual vehicles in recent German army maneuvers. Shown in the photograph at the right, reproduced by courtesy of *La Science et la Vie*, they enabled attack groups to act realistically in practice. Real tanks are forbidden to Germany under the Versailles peace treaty.



This looks for all the world like a real war tank, but it isn't. It is a dummy of wood used by German army in training maneuvers.

Opening Flowers *Serve as Clock*



Each hour during the day one of the common kind of flowers is opening. The clock faces in the pictures show the approximate time at which the flowers open.

CLOSING at night and opening to the sun are strange characteristics of flowers. Stranger still is the fact that each kind of flower has its own favorite opening hour. Some expand to the first rays of the rising sun, but others refuse to open an eye until long past noon. A few are night birds and only when the sun has set do they unfold their petals. As each flower clings to its own time and, barring clouds and storms, will open at about the same hour each day, it is possible to arrange a fairly accurate clock by choosing flowers that open at different times. The swamp rose, for instance, opens between four and five in the morning. An hour later the day lily opens, to be followed at an interval of about an hour by the black nightshade. In another hour the morning glory unfolds its petals, and other flowers follow suit during the day until the "queen of the night" opens at nine-thirty in the evening. Illustrations on this page show how, in this way, an hour-marking clock might be designed with garden flowers.

HE KNOWS CAVES. Below, Carl B. Livingston, who tells here the picture story of caves, emerges from a newly found shaft.

SEEING THE WORLD. At left, view of the Guadalupe Mountains as seen from the entrance to one of the region's big caves.

Nature, Carving Vast Caves in Rock, Surpasses Man's Mightiest Efforts

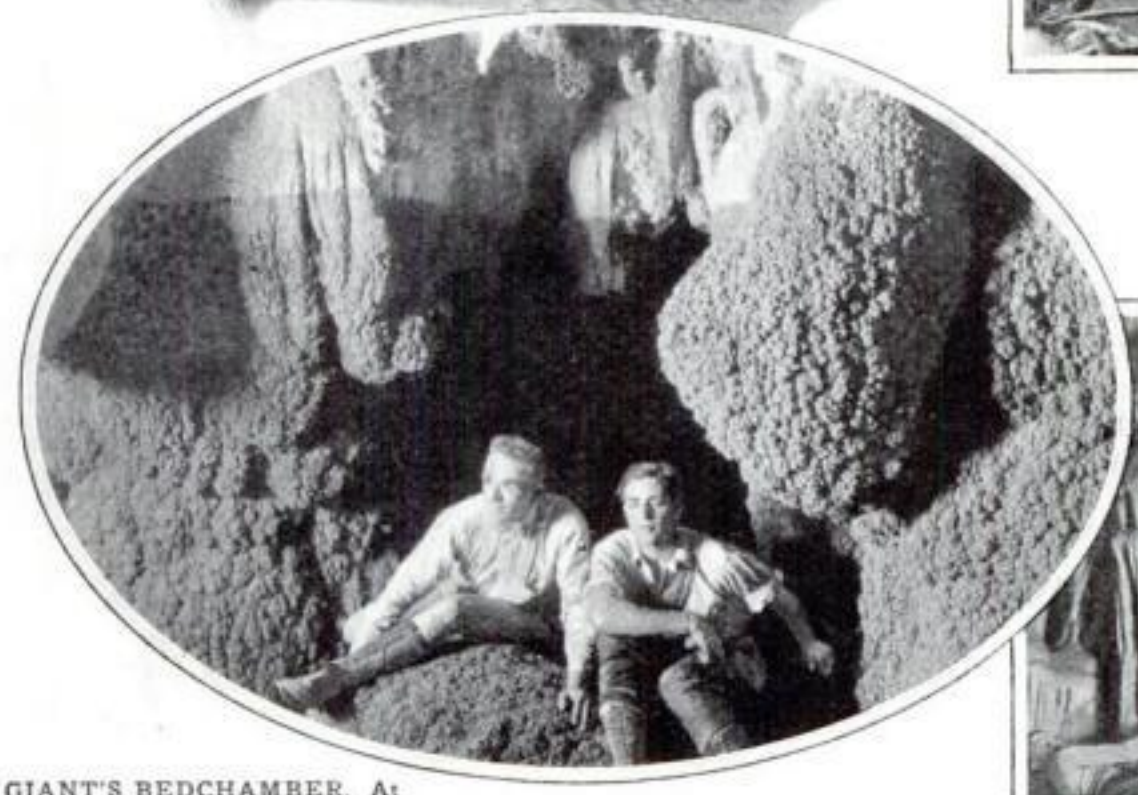
The Remarkable Photographs on These Two Pages Are from the Album of Carl B. Livingston, of New Mexico, Who Has Spent a Lifetime Exploring Underground Caverns and Studying the Processes by Which They Are Formed During the Course of Centuries

HOW CAVES DIE. This natural bridge is just a fragment of an ancient cave's roof. Through the ages, the supports wear away and the ceiling falls, leaving here and there a thin arch to mark the site of a once mighty cave that had been worn by time and water in the hard limestone of the Guadalupe Mountains of New Mexico.

NATURE'S WATER PIPES. At right, conduits, through which the limestone-loaded water flows, are built up by the springs that rise from the desert flats near the base of mountains. This unusual picture was taken along the course of the Blue Spring Creek.

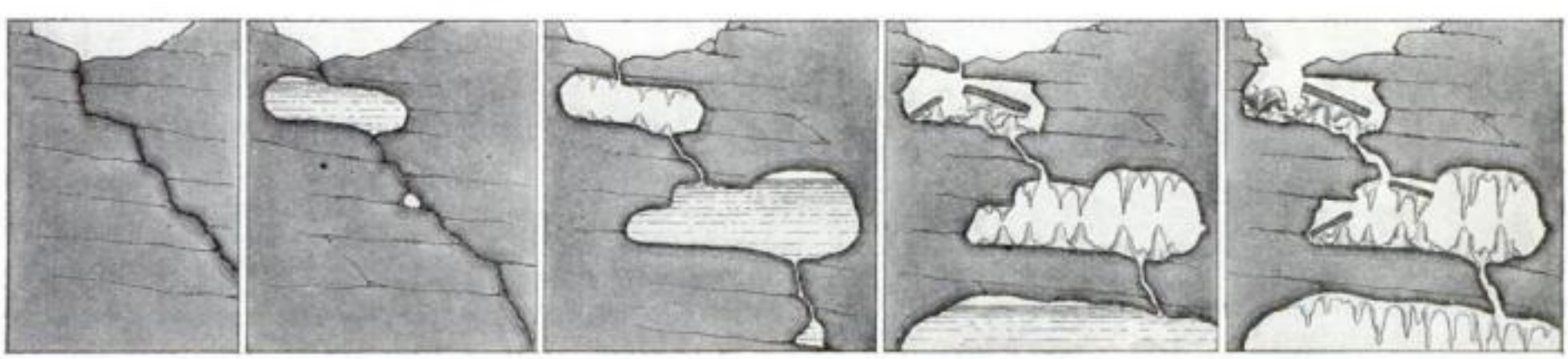
INTERIOR DECORATION. Nature does not leave her caves unadorned, as these remarkable frescoes from the ceiling of the "Club Room" of Hidden Cave prove.

BONES 4,000 YEARS OLD. Jim White, a cowboy explorer of the Guadalupe Mountains caverns, is seen here with his unique collection of bones and relics of the Basket Makers, a tribe that inhabited this region forty centuries ago and whose remains he discovered.

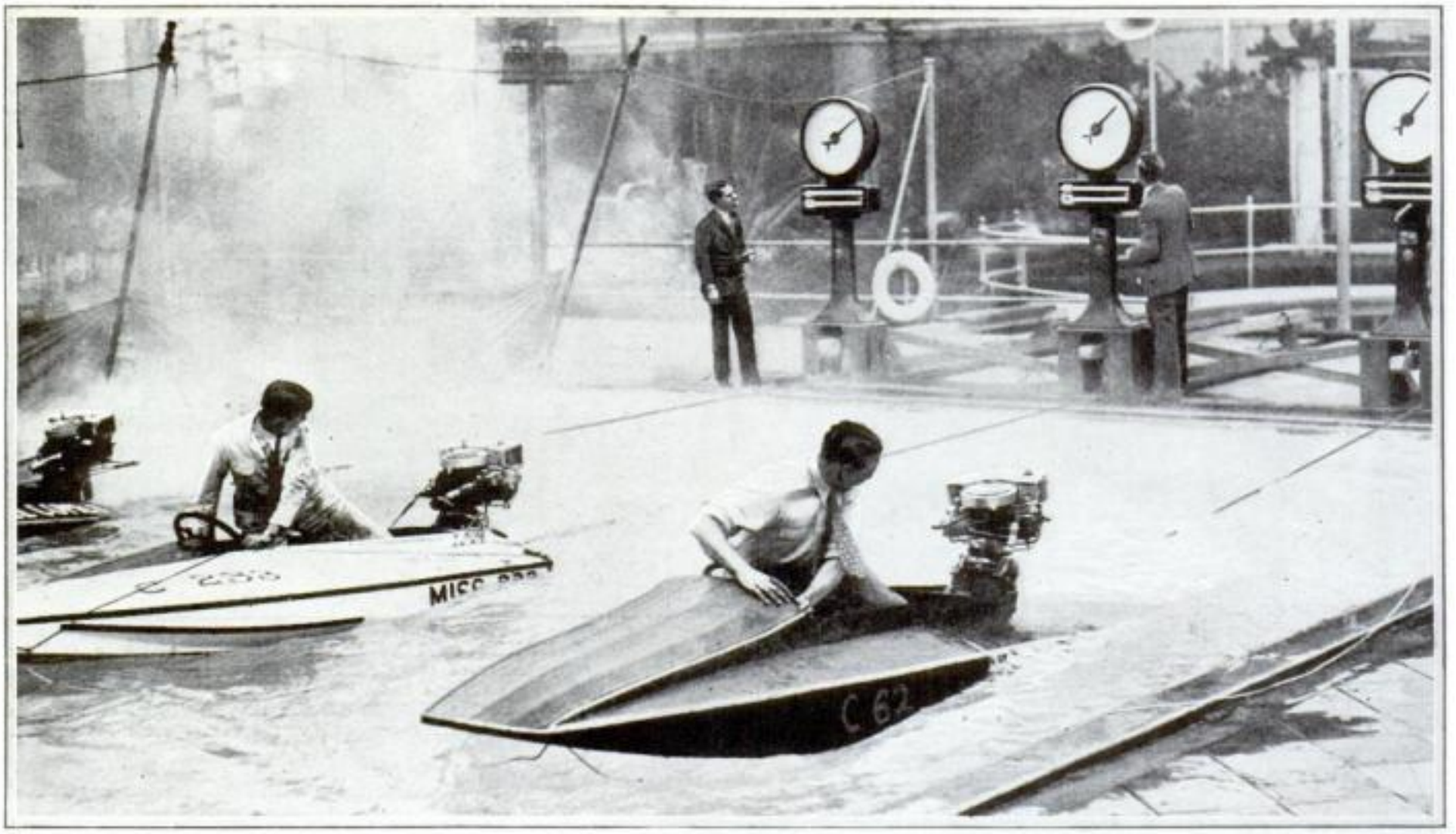


GIANT'S BEDCHAMBER. At top, the room in which the skeleton of a seven-foot Basket Maker was found. Great care was necessary in removing the bones to avoid stirring up a thick cloud of poisonous dust. In oval, photo shows the relative speed with which caves are cut by trickling water. Note the water line in this cave which was nearly filled with water when Livingston waded through it twenty-five years ago. A new chamber, cut below this one, has now drained it dry. Other deeper chambers will be cut in the rock in the course of time.

ANOTHER WORLD'S BIGGEST. Above, photo made at the base of the mightiest stalagmite in the world which rises from the floor of Livingston Cave in the Guadalupe Mountains. Formations like these are built up by the constant dripping of water, full of mineral matter. Seven years ago, Livingston placed a stick on one and returned recently to find the stick encased in stone, the stalagmite having grown half an inch beyond the marker, thus checking the speed at which stalagmites grow. At left, a natural dam in Hidden Cave. This is one of the strange freaks produced by the water that seeps through the fissures of the Guadalupe Mountains and slowly wears the limestone away.



HOW CAVES ARE MADE. A cave begins in a fault in a mountain through which water slowly seeps. A small chamber is formed near the surface and gradually fills with water. In the same manner a second chamber forms below the first, drains it, and eats out another.



MOTORBOATS RACE BUT STAND STILL

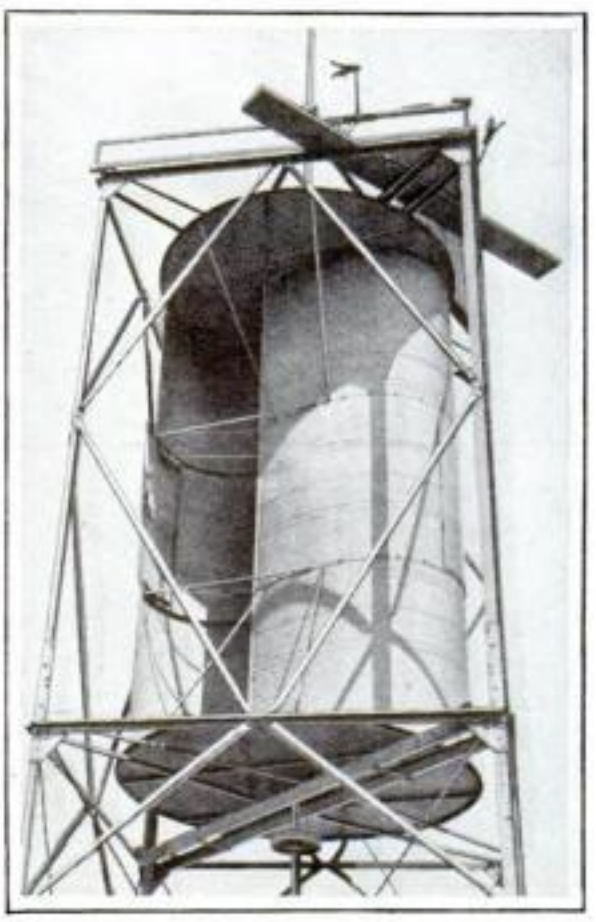
WITH motors wide open and propellers churning the water into swirling foam, three speedy motorboats raced side by side without advancing a foot. The event was a unique "standing still" motorboat race, held in a small swimming pool during a motorboat show in California. Each of the outboard-engined craft was fastened to a scales that acted as a dynamometer to record the pull exerted by the boat. The craft with the strongest pull was adjudged the winner of the race. The real thrill of the strange race lay, of course, in watching the moving indicator on the face of the dynamometer, which fluctuated slightly as propeller blades whirled against the resisting water. Additional tests are planned to determine the power of the engine and the most effective angle at which to set the propeller blades.

FASTEST GROWING PLANT

SO RAPID is the growth of a mushroom-like fungus found in Hawaii that the human eye can easily see it increase in size. Probably the fastest-growing plant in the world, its stalk reaches a height of several inches in one minute's time.

ROTOR INVENTION MAY BRING BACK WINDMILL

A NEW kind of windmill; far more efficient than the many-bladed affairs of the past, may once again cause men to harness the winds for power. A noted Finnish engineer, S. J. Savonius, recently told the American Society of Mechanical Engineers that this might happen. He described a rotor windmill of his own invention, nicknamed the "S-rotor" because a cross-section of its two blades resembles the letter S. Several of these windmills have been erected in Finland, and the first one in America was recently placed in service on the East Islip, N. Y., estate of Charles L. Lawrance, famed aeronautical engineer, to pump water for a duck pond. In Europe, Savonius declared, S-rotors had also proved practicable to harness tidal power from the sea on a small scale. These rotors may find additional uses to ventilate buildings and draw smoke from chimneys with poor draft. Savonius, making no exaggerated claims for his rotor, says it is not suitable for big power plants such as would be capable of supplying light and power to a great city, but he thinks it ideal for small plants.



America's first rotor windmill, recently erected on a Long Island estate to pump water.

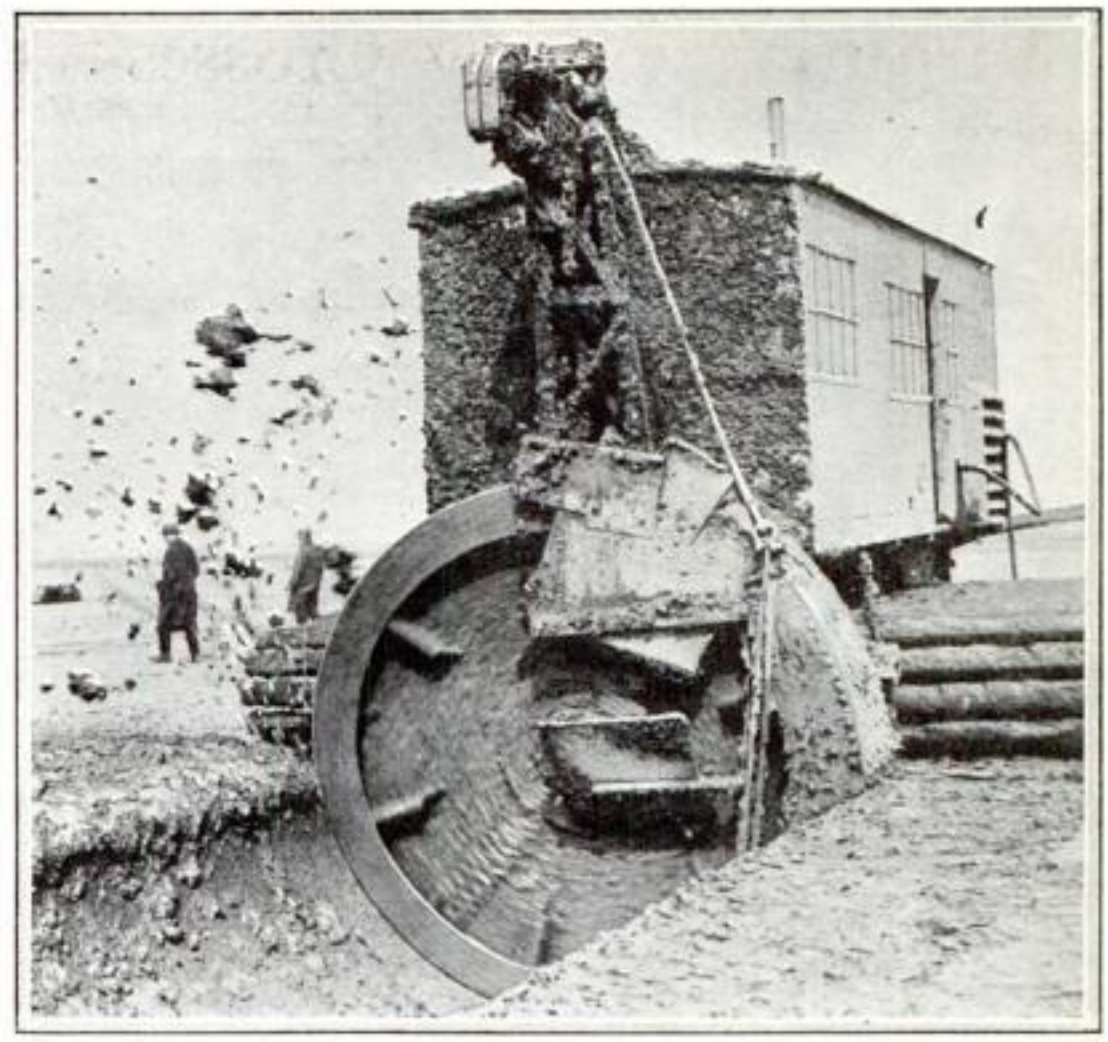
Below, the giant incandescent lamp made in Germany for use in movies and at airplane landing fields.

SIXTEEN-POUND LAMP MADE FOR THE MOVIES

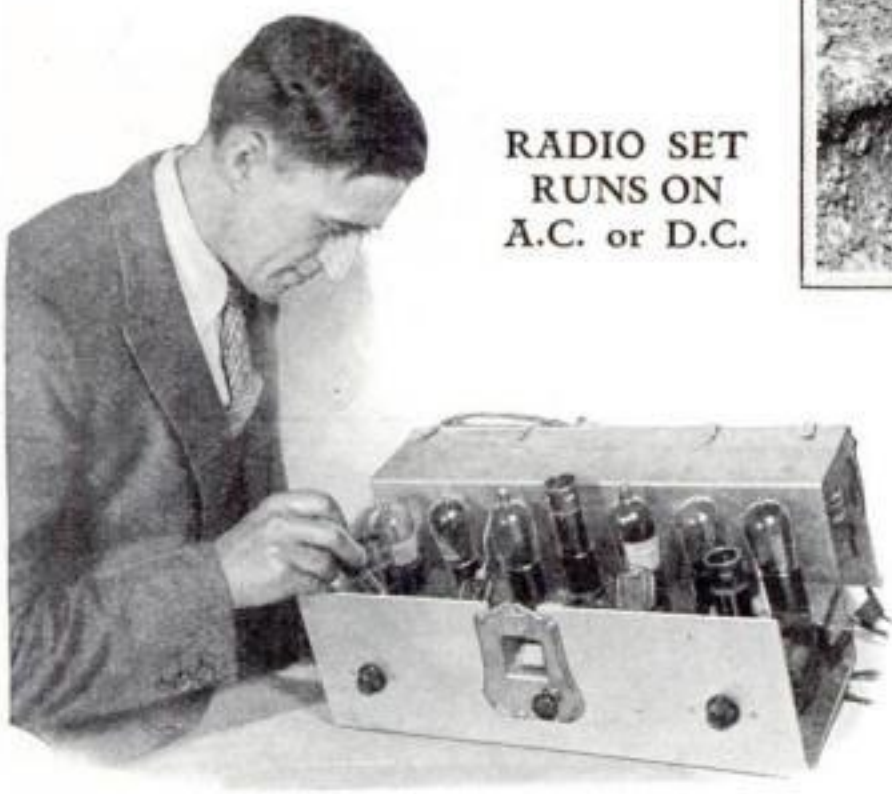
UNUSUAL in its shape is a huge incandescent bulb recently built in Germany. Intended for such uses as movie studio lighting and aviation beacons, it requires 50,000 watts of electricity to keep its filament glowing. This is sufficient electric power to feed a hundred ordinary flatirons, or to run an electric motor of more than sixty horsepower. A glass of water placed near the big lamp begins to boil in a few minutes. The bulb of this big lamp is three feet long and fifteen inches in diameter and it weighs sixteen pounds. The tungsten filaments are one tenth of an inch thick and weigh a little more than a pound. Out of this amount of tungsten the filaments for 130,000 twenty-five-watt lamps could be made.

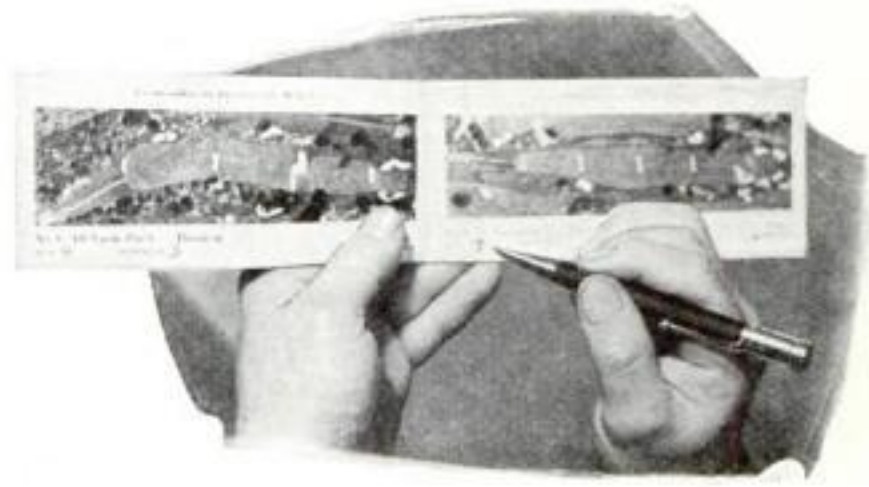
NEW DUTCH DITCH DIGGER BORES OUT THE EARTH

Violently roaring and chattering, a new Dutch ditch digger goes to work along the shores of the Zuider Zee. This machine works much like the rotary snowplows used on some American railways, for it bores its way through the earth as they do through snowdrifts. A huge circular contrivance spins around at high speed, cutting into the earth and throwing excavated material away from the side of the trench. This odd monster is driven by an internal combustion engine and is mounted on tractor treads so it easily can pass over rough ground. The shallowness of the troughs required have made possible this departure from more conventional ditch-digging machinery. America's high-speed excavators, for example, customarily employ an endless chain of buckets that scoops material from in front of the machine as it progresses, and deposits it at the side.



RADIO SET RUNS ON A.C. or D.C.

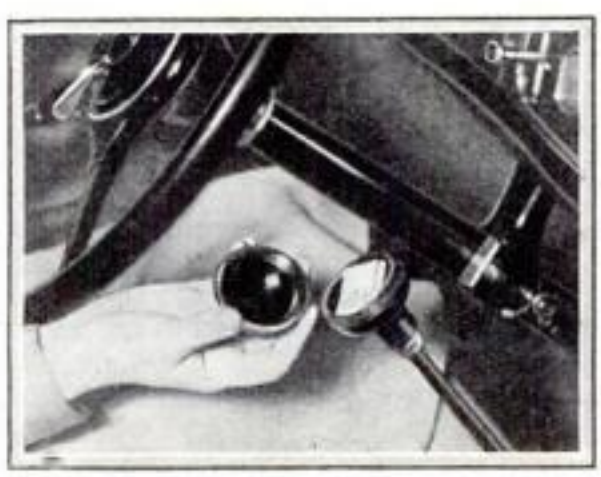


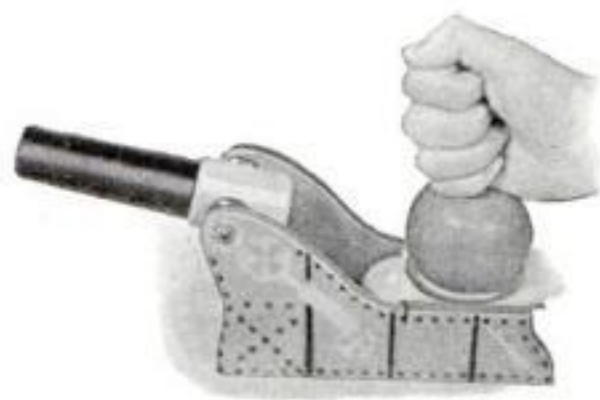


A radio set demonstrated recently by Alexis Poncel, of Brooklyn, N. Y., its builder, can be plugged into either a direct or alternating current circuit for operation. A relay in the power circuit is so arranged that it does not function when the set is running on alternating current. The set is wired so the current then goes through the usual transformers. When the set is connected to a direct current circuit, however, the relay immediately connects the 110-volt line directly to a filter circuit, cutting out the transformers. Heating elements in the tubes are connected in series through resistances to the power line.

HANDY GEAR SHIFT KNOB

A new knob for the gear shift lever is a handy receptacle for carrying coins, tickets, and other articles. The cap is removable, exposing a small compartment in the hollow knob. The lid screws on firmly and there is room in the cavity for several small articles.





LOUD CANNON IS SAFE

A novel toy cannon gets its crash in the same manner as you make a noise by striking and bursting an inflated paper bag. At the rear of the cannon is a rubber ball partly open at its bottom. Across this opening a thin strip of paper is unrolled from a coil. Striking the rubber ball smartly with the clenched hand compresses the air in the ball suddenly, which breaks the paper and causes a loud "pop."

GOLF COURSE AIR MAP USED AS SCORE CARD

Golfers are now offered a score card made of aerial photographs. An aviator makes an air map of the course, from which individual pictures of each hole are taken. These are bound together in book form. On each picture distances along the fairway are marked in hundreds of yards. This aids in recording the length of shots and in determining the distance the ball lies from the hole. At the bottom of the page is space for players' names, number of strokes, length of the hole, par, and direction of wind at the time of play. As each stroke is made its direction and distance is drawn on the photograph with pencil or pen. Usually a dotted line represents the course of one player's shots, while a solid one represents those of his opponent. When the round is finished there is thus a stroke by stroke record of it. This can be kept as a souvenir or used as a study for correcting faults of play. The pictorial score card should prove especially valuable when a player is on a strange course that has greens invisible from the tee or when the width of a water hazard is unknown. If made of a championship match, it would give golf fans unable to attend a stroke-by-stroke score.

Virginia's "Fairy Crosses" Baffle the Geologists

This cabin occupied by natives in Patrick County, Va., is in vicinity of the "Fairy Cross" region.

Above, "Fairy Crosses" in their natural state just as they are found in the Virginia hills. At left, close-up of one of the crosses, the origin of which is a mystery.

IN PATRICK County, Va., and nowhere else in the world, is found the "fairy cross" of the Virginia Blue Ridge, a rock formation taking the form of a perfect cross, and for which science has found no satisfactory explanation. Each of these little brown rocks, worn smooth by no one knows how many centuries of exposure to the elements, bears the form of a cross, often as clearly outlined as though chiseled by the hand of a master.

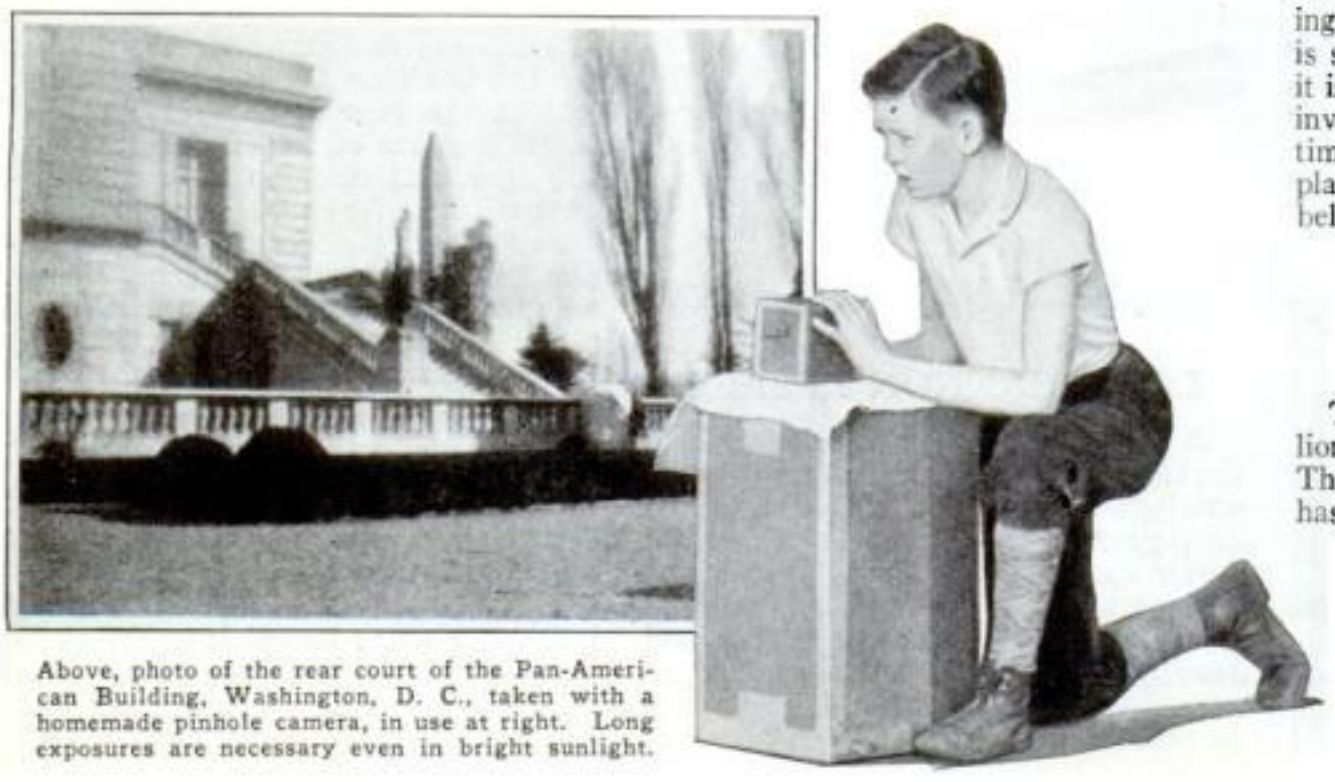
The most nearly perfect crosses are found on the surface of the soft soil, but similar formations have often been found embedded in the underlying rocky ledges.

While the existence of the crosses has long been known, the first attempt to study them was made a few years ago by the United States Geological Survey. This work confirmed the presence of the crosses in their natural state, and, in a detailed report, said: "Perhaps the most curious mineral found in the United States is Staurolite, otherwise known as 'Cross-Stone.' It is an iron-aluminum silicate found only in Virginia, the reddish-brown and brownish-black crystals occurring in well-defined single crosses."

BOYS FORM PINHOLE CAMERA CLUB

IN WASHINGTON, D. C., the younger members of the Y. M. C. A. have formed a novel camera club. Each member builds his own camera out of cardboard, with a pinhole in a piece of black paper for a lens and cardboard for a shutter. Standard three and one fourth by four and one fourth inch cut films are used. One film is loaded into the camera in the darkroom and the proud owner sets out to take a picture.

No focusing is necessary, but the pinhole admits light so slowly that long time exposures are required. Instead of tripods, the boys rest their cameras on cardboard cartons, boxes, or any convenient natural support. They do not use finders. V-shaped pencil lines drawn on top of the cardboard cameras suffice to aim them. As their cameras cost nothing, the boys have to pay only for the films, developing paper, and the necessary chemicals. The article on page twenty-one gives new developments in using a pinhole camera.



Above, photo of the rear court of the Pan-American Building, Washington, D. C., taken with a homemade pinhole camera, in use at right. Long exposures are necessary even in bright sunlight.

NEW EYEGLASS LENS IS UNBREAKABLE

Thin celluloid between two pieces of glass makes new unbreakable spectacle lenses.

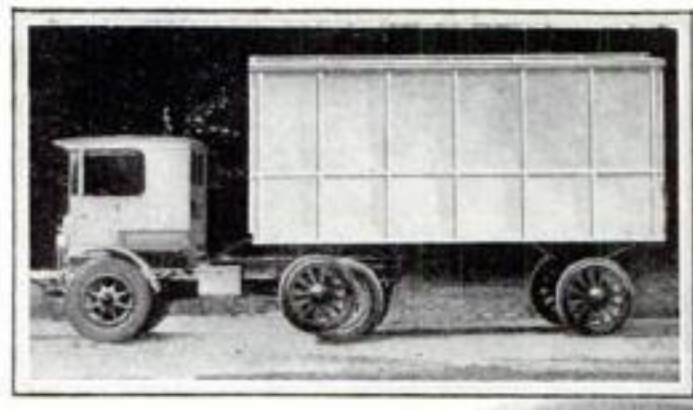
UNBREAKABLE spectacle lenses are a recent invention. Two pieces of glass with a piece of celluloid between them are cemented together under pressure, forming one solid piece. This "glass sandwich" is slightly thicker than ordinary glass but it is just as transparent, the celluloid being invisible. Unbreakable glass has for some time been used in auto windshields and airplane and factory goggles, but this is believed to be its first use in spectacles.

AIRPLANE BARRED IN HUNT FOR LIONS

THROUGHOUT British Africa, hunting lions from airplanes has been prohibited. The open nature of African game country has made use of planes for this sport comparatively easy. Authorities now fear that continuance of the practice may result in extermination of the "king of beasts." They believe lions should be protected, since they form a natural check on the size of herds of wild grazing animals.

NEW FREIGHT PLAN LINKS HIGHWAY TO RAILS

Freight transported on wheels directly from manufacturer to consumer, without a single stop for unloading and reloading en route, is the proposal of Col. Joseph C. Bonner, transportation engineer. Recently he demonstrated in New York City, with the aid of models, how "rail wagons" of his invention would make this possible for steam railroads. These axleless rail wagons travel with equal ease on highway or railroad. They roll up to a factory door for loading. A truck then tows them to a railway siding. Here they slide upon flat cars that carry them bodily to destinations hundreds of miles away. Eventually the rail wagons are slid from the flat cars and towed to the consumer through the streets. A special ramp built into railway sidings facilitates the loading and unloading of the rail wagons upon flat cars. Towed up this ramp, they automatically straddle the flat car and are locked in place. At the destination, a brakeman works an unlocking gear on each car and the engineer takes the train of flat cars out from under the rail wagons, which are then towed away. The running gear of the flat car and the rail wagon are thus two separate units. The wagon is equipped with permanent wheels suited for use on the public highway. Far from a visionary idea is Col. Bonner's plan. It already has been tried out successfully upon an electric railway in Ohio, where these photographs of full-sized rail wagons were made, and Bonner foresees its more general use. A railroad needs only one new item of equipment—the special ramps for loading and unloading—to handle the rail wagons and flat cars.



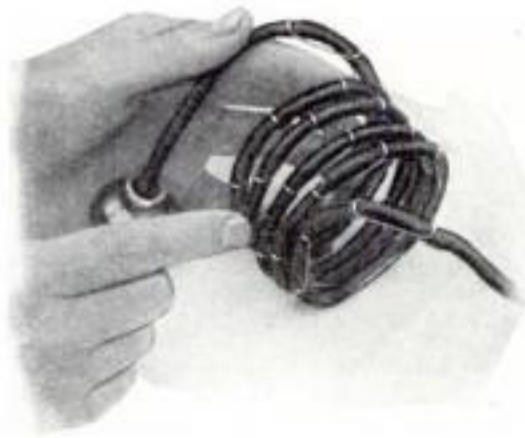
Col. Joseph C. Bonner, transportation engineer, demonstrates with models his proposed system of rail wagons that ride on flat cars and can also travel along the highway.

Above, a full sized rail wagon on its way to the railroad station. Below, rail wagon at the siding is put on a flat car.

Three of the rail wagons are here loaded on long flat car and are ready for shipment. When the train bearing these containers arrives at its destination, they are shunted on siding with special ramp. This lifts off the rail wagons, which are then towed to the consignee.

WIRE AROUND ELECTRIC CORD PREVENTS KINKS

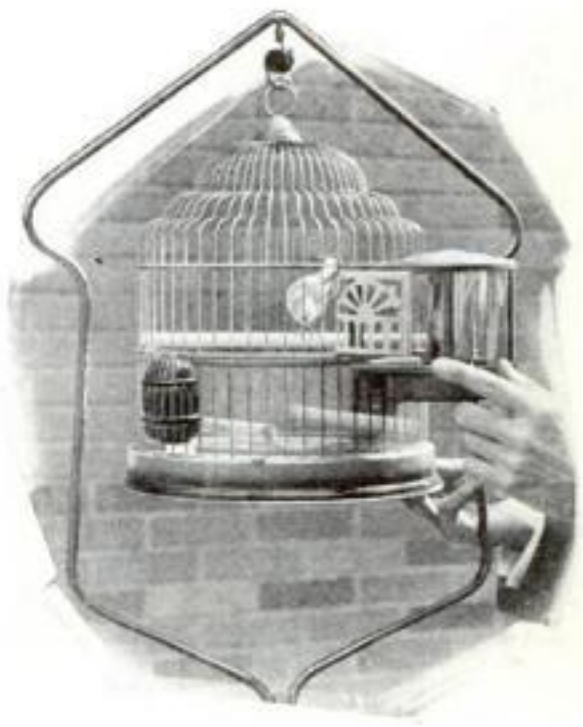
A new electric cord for portable appliances like vacuum cleaners, flat irons, or drills cannot kink or snarl. It is encircled by a wire guiding device. This consists of alternately straight and looped wire, extending outside the electric cord for its entire length. The wire thus keeps the cord free of kinks for the distance from plug to appliance, without shortening its scope. While the new cord is nonkinking, it remains perfectly flexible and may be bent around or over obstructions like any standard cord. The device could also be applied to the wire on a telephone.



Straight and looped wire encircles this electric cord and keeps cord from kinking.

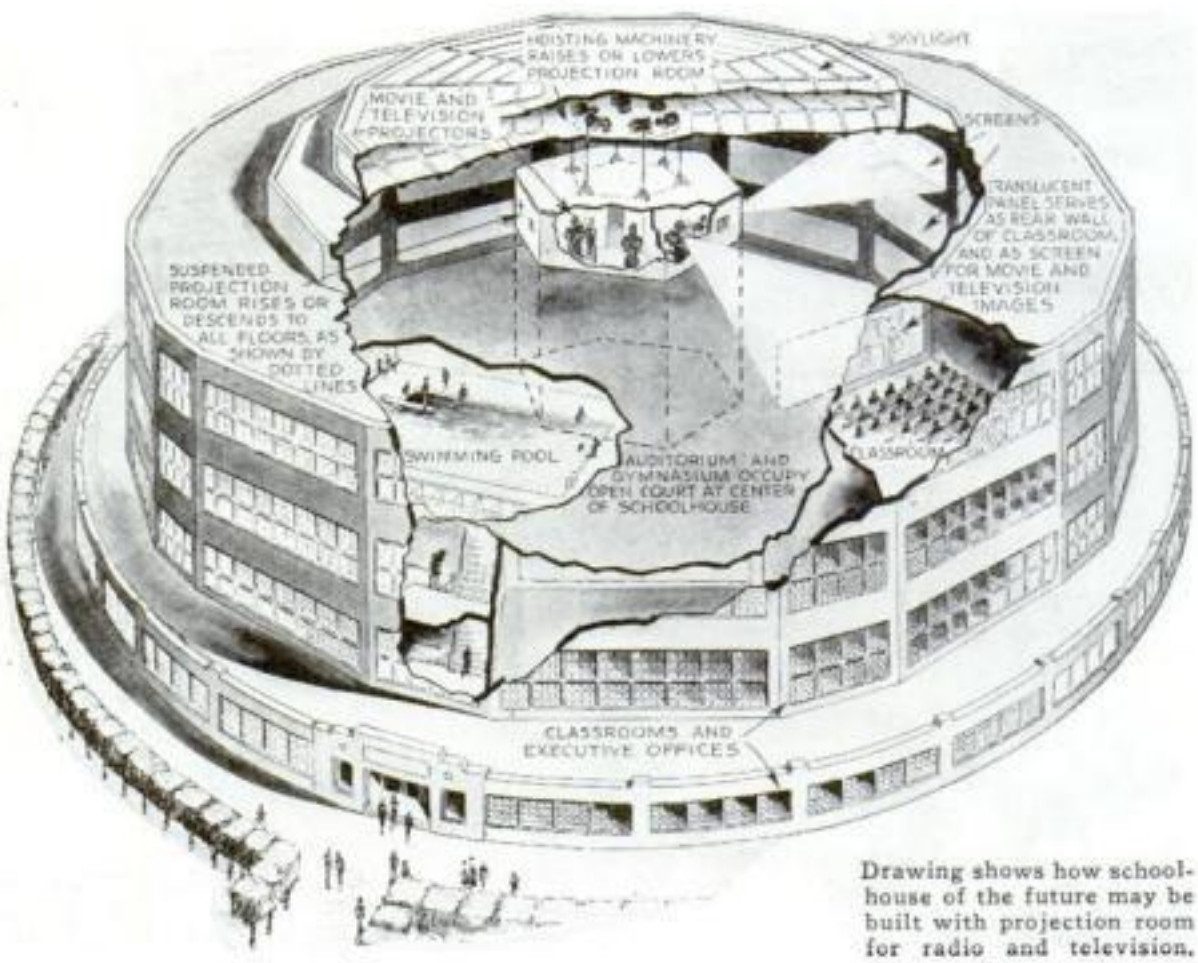
CANARY IN CAGE CAN HAVE PRIVATE BATH

Now bird cages are acquiring all the comforts of home. A new bird bath compartment for cages is made of glass, like those in the latest bathrooms. Canaries may splash around to their hearts' content, without scattering water over their surroundings. Perhaps they will sing in their baths, as so many humans are fond of doing. The compartment is removable for filling and emptying.



Every pet canary can now have its own glass bathing compartment and avoid spattering.

SCHOOLHOUSE OF FUTURE TO BE LARGELY OF GLASS



Drawing shows how schoolhouse of the future may be built with projection room for radio and television.

THE "little red schoolhouse" of the future, according to Joseph Duke Harrison, New York City architect, may resemble a wedding cake on a platter. Recently he exhibited a design for a large circular structure with walls and most of its roof of glass. Classrooms are arranged around a big circular assembly hall, extending through the building from first floor to roof. Being of glass at this point, the roof would furnish lighting for the assembly hall. The outer wall of each classroom would be of glass, while their inner walls, facing over the assembly hall, would be translucent screens. On these, motion pictures could be thrown from a projection apparatus suspended from the roof over the center of the assembly hall. Hoisting machinery to raise or lower it to any floor is mounted just beneath the central skylight. Radio, motion pictures, and television, when perfected, would be tools of education in this school of tomorrow, says Harrison. The basement of this odd building would be devoted to gymnasium, swimming pool, and locker space. Concentration of facilities, without sacrificing light and air, was the thing most sought for in this design, according to the architect. At the left is shown our artist's conception of the future schoolhouse.

SCHOOLBOY INVENTS AUTOMATIC WHISTLER

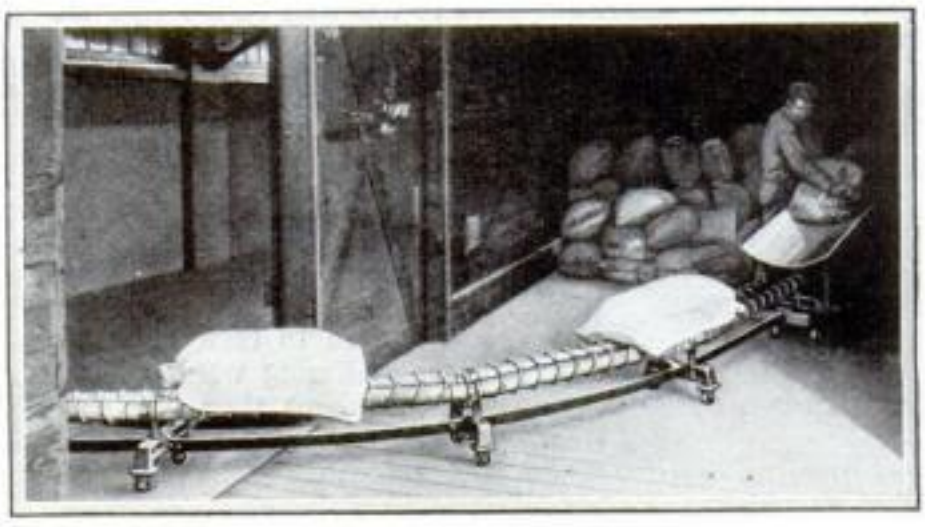
AN EARLY start upon an inventive career is that of Warren Prince, high school senior of Kansas City, Mo., who already has two patents to his credit. Recently he demonstrated one of his inventions—a mechanical whistler that will transform the most casual purser of lips into an accomplished musician. Placing this flat box of aluminum or celluloid to his lips, the player turns a crank, and as he blows, sibilant strains of technically perfect music issue from the instrument. A perforated roll operates ten whistles on the principle of a player piano. Prince is also the inventor of a traffic button with hidden spikes to guard a highway safety zone. Mounted nearly flush with the pavement on a stiff spring, it would not be affected by a pedestrian's weight. But a car trespassing upon it depresses the marker, and spikes appear through holes in the cover and puncture its tires. After one encounter with the device, motorists steer clear of it.

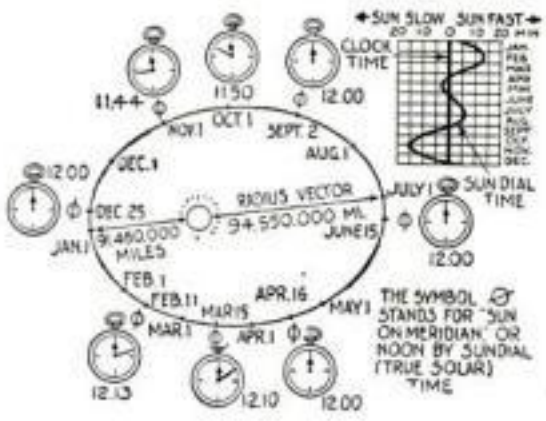
MACHINE PLOWS WHILE FARMER SLEEPS

A PLOW that works while the farmer sleeps was tried out the other day at Northampton, England. Set in motion one evening it obediently worked all night long without human attention, plowing a broad field in the course of its night's work. This odd machine is driven by a gasoline engine that works two cable drums. These haul it from one end of the field to the other by alternately reeling in and paying out wire ropes. As it reaches the limits of the field the automatic clutches on the cable drums work with almost human intelligence and the machine reverses its course. The device, shown above, was invented by a British war veteran of Northampton.

NEW WHEELED CONVEYOR MOVES BAGS

A FLEXIBLE conveyor system on wheels for loading and unloading freight cars carrying bagged and baled materials has just been placed on the market. It speeds up the work, requires fewer men, and can be moved about to send the bags around corners or into the warehouse rooms. This one-man outfit is a new development of a screw conveyor system introduced some years ago. Sections of spiral tubes, revolved by an electric motor, have screw-like threads on the surface that keep the bag moving. The load moves at the rate of ninety feet a minute.





YOUR WATCH RIGHT FOUR TIMES A YEAR

No timepiece on earth, however accurate, can give the true solar time of noon except on December 25, April 16, June 15, and September 2. On every other day of the year every clock or watch is either behind or ahead of the true solar noon told by a sundial.

If the earth's orbit were a perfect circle, the clock and the sundial would agree in telling noon simultaneously all the year round, for the pull of the sun's attraction would keep the earth moving at a constant, uniform speed.

But the earth's path is an ellipse, with the sun at one of its foci. The radius-vector, or line joining the earth and sun, varies in length. It is shortest about January 1, with its maximum length about July 1. The earth is therefore running downhill, pulled by the sun's attraction, from July to January, and uphill, against the solar pull, from January to July. Its speed grows through the down grade and is slowed through the up grade.

The result is that the solar day (from noon to noon) is shortened while the earth's speed is being accelerated, and lengthened while it is being retarded. Therefore, on November 1 sundial noon comes at sixteen minutes before noon by the clock, for the solar attraction is sweeping us to our closest approach sunward.

On February 11, with the radius-vector lengthening, and the earth's momentum being braked by the sun's pull, sundial noon cannot come until thirteen minutes after noon by the clock. The four times when the world's clocks and watches are right by the sun are at the points in the orbit where the length of the solar day passes through the mean or average value that has been adopted as the world's twenty-four-hour standard unit day.

The heavy straight line in the graph represents standard clock time. The waving line shows the variation from it of sundial time.

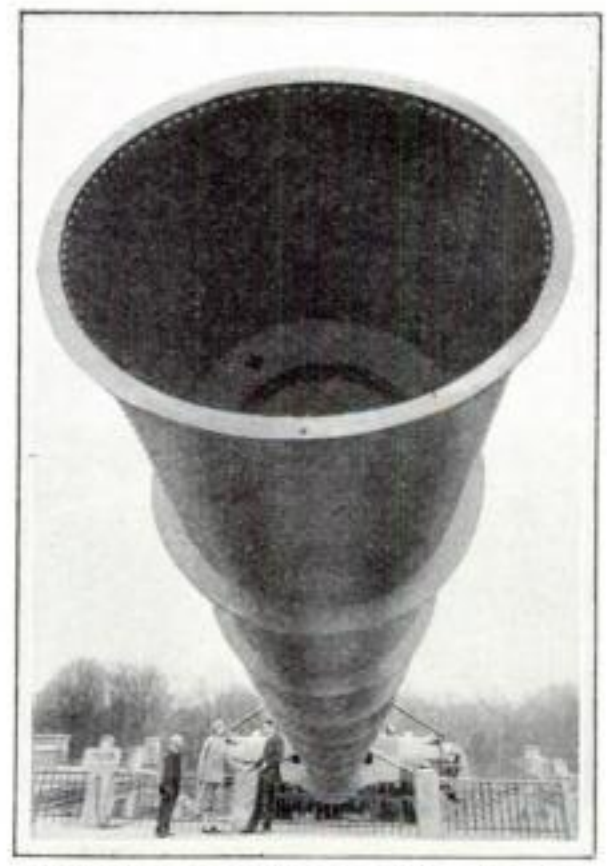
TRICK LENSES ADD COMEDY TO MOVIES

In a little workshop in Los Angeles, Calif., sits a man who for your amusement distorts normal looking movie actors and actresses into freaks. He is James Herron, and he makes the lenses by which strange distorted effects are produced in some motion picture comedies. Impossibly short fat men, amazingly tall and lathy actors, and motor cars flattened out like pancakes move about on movie screens, because the normal originals were photographed through one of Herron's trick lenses. One of his latest achievements is a lens that will permit seven pictures of the same object to be made at once on the same film. The shape of Herron's lenses is worked out in advance on paper with mathematical accuracy to insure getting the particular effect desired by the director of the movie comedy.

Above, James Herron, who makes movie actors look like freaks with the use of the strange lenses, left, he shapes for studios.

REFRACTING TELESCOPE LOOKS LIKE MEGAPHONE

Like the horn of a gigantic megaphone, the barrel of a new refracting telescope at Berlin-Treptow, Germany, looms up over its surroundings. This huge instrument, almost as long as an American railway passenger car, is said to be the largest of its kind in the world. An observer looking through its eyepiece sees distant heavenly bodies directly through its lenses instead of indirectly by mirrors as in the huge Mount Wilson, Calif., telescope and others similar to it. This photograph was taken while the observatory was celebrating its thirty-fifth anniversary.

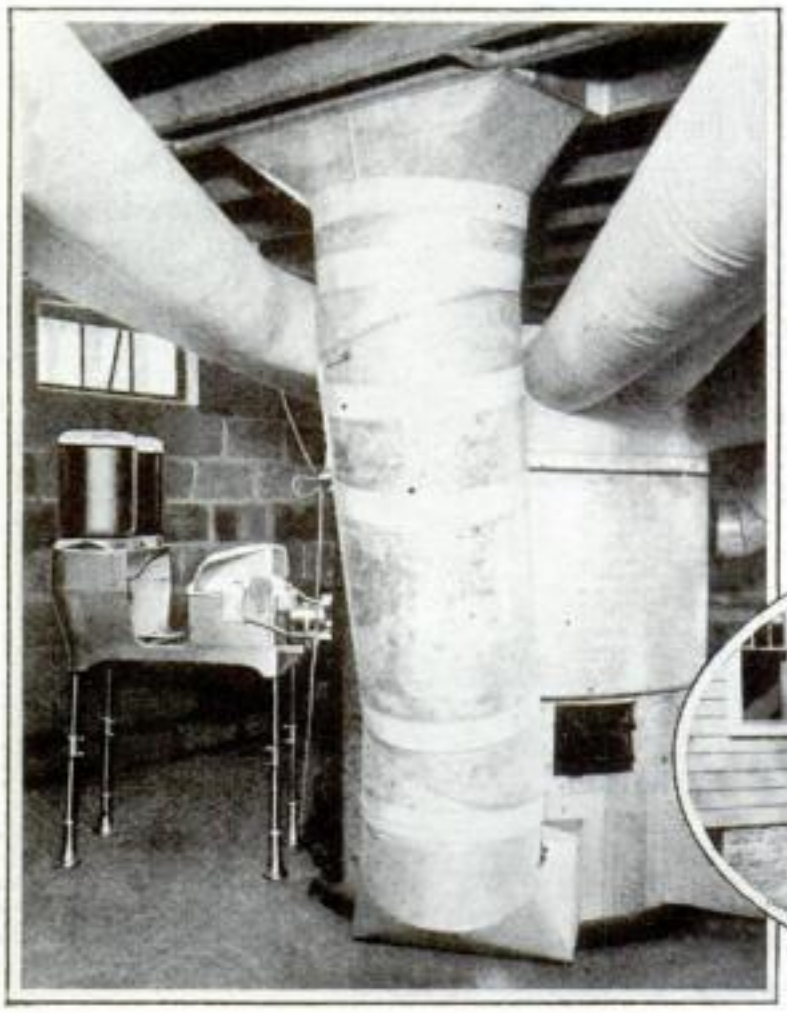


This is not a giant's megaphone but the barrel of the biggest refracting telescope.

SUNDIAL TELLS TIME SUMMER OR WINTER

Shaped like a segment of melon rind and suspended by its points from the arms of a semicircular frame is a new sundial invented by a California man. It tells time with equal accuracy in summer or winter. Red lines for the hours and fractions, and black lines for the minutes, cross the inner surface of the bronze casting. The time is indicated by the shadow of a metal pointer falling on one of these lines. The lines are made in the shape of a flattened letter "S." Thus the shadow cast by the pointer falls always on the same line, whether the sun is at the southern limit of travel as in our winter, or whether it has come north as it does in our summer. The dial rests on a concrete pedestal over three feet in height. From the base of the dial to the top of the arms is sixteen inches. The arm in the foreground in the picture above supports the shadow pin. On the back of the rear arm is a set screw that is used for lowering or raising the time face plate.

PORTABLE OIL BURNER GIVES INSTANT SERVICE



A NEW oil burner for home use is portable and as easily installed as a vacuum cleaner. It requires no permanent system of pipes or wiring, no changes in furnace bricking, or the removal of grates. When being installed its nozzle is thrust into the opened furnace door, an electric cord is plugged into a lighting socket, and the burner is ready for full automatic operation. Servicing is as simple as installation, due to the portability of this contrivance. If a burner requires attention from the dealer, he simply replaces it with a new one, a matter of minutes, and takes the old one away. When the heating season is over this burner can be taken out of the furnace and connected to a hot water heater or incinerator. It can also be used by people who rent their homes, since they can take it about with them whenever they move. For operation immediately after installation, the oil supply is two large glass containers mounted on the base. These hold enough fuel to run the burner for thirty-six hours, during which time a tank may be installed in the cellar and connected to the machine by copper tubing. The burner is made in models for electric or gas ignition, and is approved by the Underwriters' Laboratories, Inc.

BEANS INDIANS LIKED MAY ALSO PLEASE US

UNKNOWN to most American tables are screw beans, one of the strange foods that hundred of years ago helped stay the hunger of Indians. But one of these days they may appear at the corner vegetable market, if the plans of the U. S. Department of Agriculture materialize. Its experts, under Dr. E. Yanovsky, have collected more than one hundred different food plants once raised by the North American Indians, but now uncultivated, and for the most part totally unknown by the present generation. Some of the most promising, which contain valuable food elements—including the screw bean—are being grown on the Pacific coast for further study. Eventually the Department of Agriculture hopes to popularize them.

NEW RADIO SET WORKS IN YOUR CAR OR HOME

A RADIO set that can be carried about like a suit case is designed for the convenience of fans who do not want to miss favorite programs while motoring. Fitted with two connector cables, it can be plugged into a lighting socket in the home or to a socket wired to the batteries of a motor car. When used in an auto, the set is fixed in back of the front seat. No adjustments are necessary in changing it from car to house or vice versa. One plug adapts it to auto batteries and a second to house wiring. It has been used in motor boats as well as autos, and in summer camps wired for electricity. The set is inclosed in an aluminum case fourteen inches high, with a carrying strap.

In a car, this radio is hung on back of front seat. It can also be used in home.

ALL MUSCLES USED IN RIDING HOBBYHORSE

ONE of the newest of exercising devices is a mechanism that somewhat resembles a hobbyhorse without rockers. Seated in its saddle and operating this odd contrivance, the user can exercise and develop all the principle muscles of his body. A pair of pedals work a crankshaft device which imparts an up and down motion to the saddle similar to that experienced in riding a horse at a trot. Assuming different positions on the machine while working it develops legs, back, stomach, or neck muscles. The machine is designed for the use of invalids as well as for those who wish to reduce with the aid of scientific exercise.

GIGANTIC GIRDER ROLLS ALONG CITY STREETS

Above, rolling a 105-ton girder through ~~Los Angeles~~ streets. At right, diagram shows how the mass of steel was moved.

A BRUTAL load was imposed on the streets of Oakland, Calif., the other day when a 105-ton girder, said to be the largest ever put together on the Pacific coast, was moved over them, to be used to support the balcony of an Oakland theater. The drawing and photograph above show the unusual method used for this task. A block and tackle hauled the immense beam forward on its slow journey. One end of the system of wire ropes and big iron blocks or pulleys was made fast to a hitching post fastened in a manhole in the streets. A tractor hauled on the tackle, inching the big beam up to it. Then the hitching post was shifted to the next manhole up the street and the process was repeated. The enormous crushing weight of the gigantic steel beam was hauled for thirty-three blocks over the city streets without damaging them. On the same principle that many hands make light work, a series of wooden rollers made a light weight of the great girder by distributing its load over a wide area. At either end of the 120-foot beam were bolted two large steel crosspieces. The ends of both these rested on large wooden shoes or skids. Each of the four shoes was carried on a pathway of wooden rollers. As the girder moved forward on its journey, the rollers it had passed over were taken up and placed in front of it by workmen.

RADIO BROADCAST MUSIC WORKS NEW COMPASS

RADIO music, instead of code signals from special stations, soon may be a means of guiding ships into port. A new radio direction finder, demonstrated the other day by its inventor, Gerhard Fisher, of Los Angeles, Calif., can be employed to pick up radio programs from broadcasting stations. This device, designed for a Pacific coast yacht, is designed to replace the usual type of radio compass. A large ring loop is mounted on a vertical shaft that can be turned in any direction. The shaft is fixed on a base that is fitted with a graduated scale so the navigator can read off the direction from which the broadcast is coming. Somewhat similar devices have been tried out in airplanes.

This new radio compass is designed to guide ships by music programs instead of code.

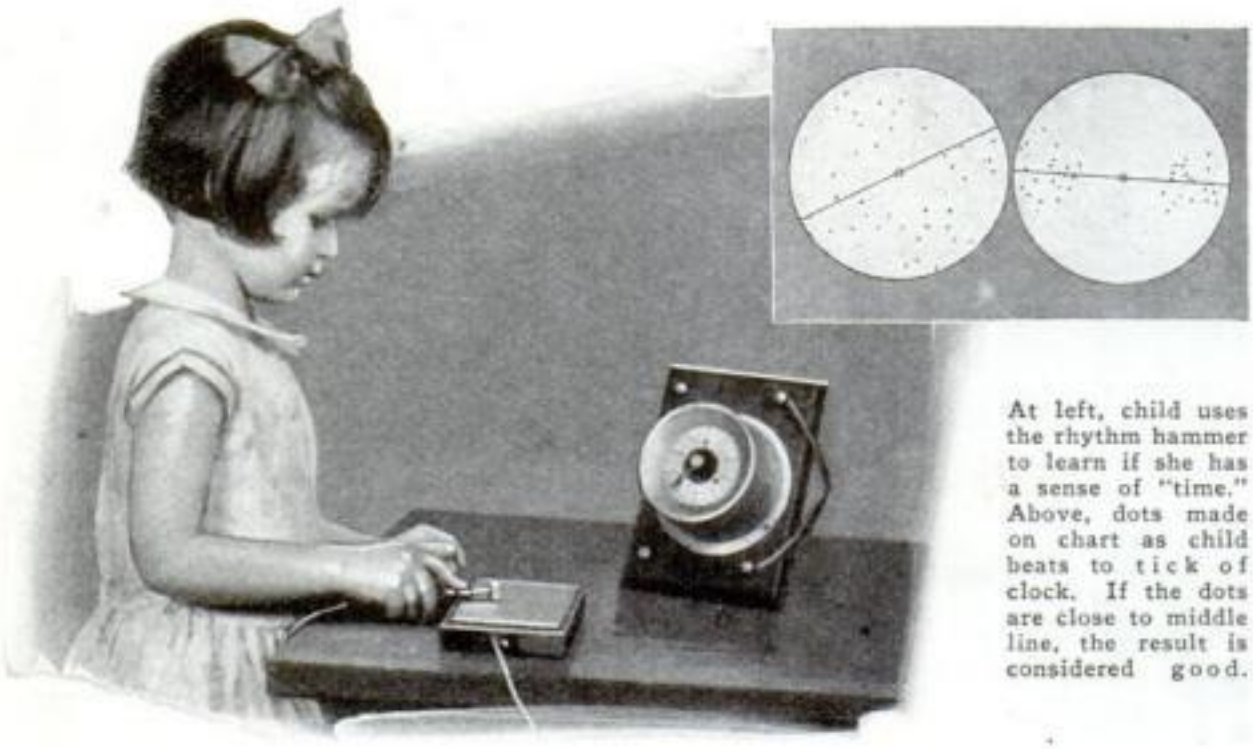
TOWED MOTORCYCLE AIDS CAR DELIVERY

A NEW type of motorcycle is a convenience to garage men who have to deliver cars at the homes of customers. When an attendant goes out with such a machine, he tows one of the new motorcycles behind it. Having delivered the auto, he mounts his motorcycle and drives back to the garage. The new machine is built in the form of a tricycle. A novel feature is a padded clamp that permits it to be attached to the rear bumper of a customer's car without scratching. When the motorcycle is ridden by itself, skidding is guarded against by use of a rear wheel differential and brakes on each of the three wheels. A "four-wheeled" motorcycle designed for towing service was described in an earlier number of this magazine (P. S. M., Feb. '31, p. 38). Two of its wheels folded up when ridden.

GOLF CLUB HAS LEVEL

BEGINNERS at golf can now use a driver with a spirit level set prominently in its head. When addressing the ball, one can see at a glance whether or not the sole of the club is being held flat on the ground. Practice with this driver is said to aid in acquiring a proper swing and in following the true arc of a circle.

TESTS NOW SHOW IF CHILD IS TONE DEAF OR MUSICAL



At left, child uses the rhythm hammer to learn if she has a sense of "time." Above, dots made on chart as child beats to tick of clock. If the dots are close to middle line, the result is considered good.

HAS Junior a natural ear for music? Or are his piano lessons wasted effort? It's easy to find out at once, according to Prof. Harold M. Williams, of the University of Iowa Child Welfare Research Station. Tests he has devised show whether a child has a real sense of rhythm and whether he can keep a tune in singing.

A rhythm hammer provides the first test. With it a child is asked to tap on a plate, in time with the clicks of a special electric clock. Electric wires lead from plate and clock to another room, where on a chart whirled by a phonograph turntable an automatic pen records how closely the child has followed the clock's beat. In another test, a child is asked to sing a song he has learned. An experimenter sits near by with a telephone transmitter. In another room, a special photographic apparatus makes a sound picture of the child's singing and shows whether he can carry a tune.

"TALKING" SCARECROW SAVES FARMER'S FRUIT

A SCARECROW that talks keeps fruit-eating birds away from a berry farm near Portland, Ore. When the farmer discovered that his berry patches were furnishing free meals for large flocks of crows and robins, he rigged a loudspeaker up inside his scarecrow. The scheme worked successfully so far as bird pests were concerned, and he has never been troubled with them since fixing up the "talking" scarecrow. This contrivance, however, is said to have attracted many song birds to the vicinity.

DOORBELL WITH SPECIAL BUTTON WARNS OF FIRE

YOUR doorbell becomes a fire alarm with the addition of one or more new fire-detecting buttons connected in the circuit and placed at points of vantage. Whenever the temperature rises beyond a predetermined point, an electric contact is made automatically on the button. The doorbell then rings the alarm. If preferred, the button may be wired to the telephone; in case of fire it would close the circuit just as if the receiver were lifted, indicating trouble to the operator.

FAN DRAWS OFF DUST IN SANDPAPERING MACHINE

DUST made by a new portable sandpapering machine is caught by a bag on the machine itself in much the same manner as sweepings are collected in the sack of a vacuum cleaner. A powerful fan creates a vacuum, drawing dust off the sanding belt and depositing it in the bag. Quick-acting fasteners enable the bag to be opened and emptied in a few seconds' time. Collecting the dust in this manner keeps the sanding belt sharp for a longer time than when no bag is used, since the dust gets no chance to clog its cutting surface. It also keeps the floor clean.

SECOND HANDLE ON NEW SHOVEL SPEEDS WORK

AN ODD shovel that is expected to lighten the labors of its user and speed up his work has two handles. It resembles a standard shovel with an ordinary handle, except that a second grip has been pivoted to the longer one just back of the shovel blade. When in use the workman takes hold of the shorter handle with his left hand. This gives a good leverage and enables him to dig and maintain a comparatively upright position, less tiring than back-breaking crouching posture formerly necessary.

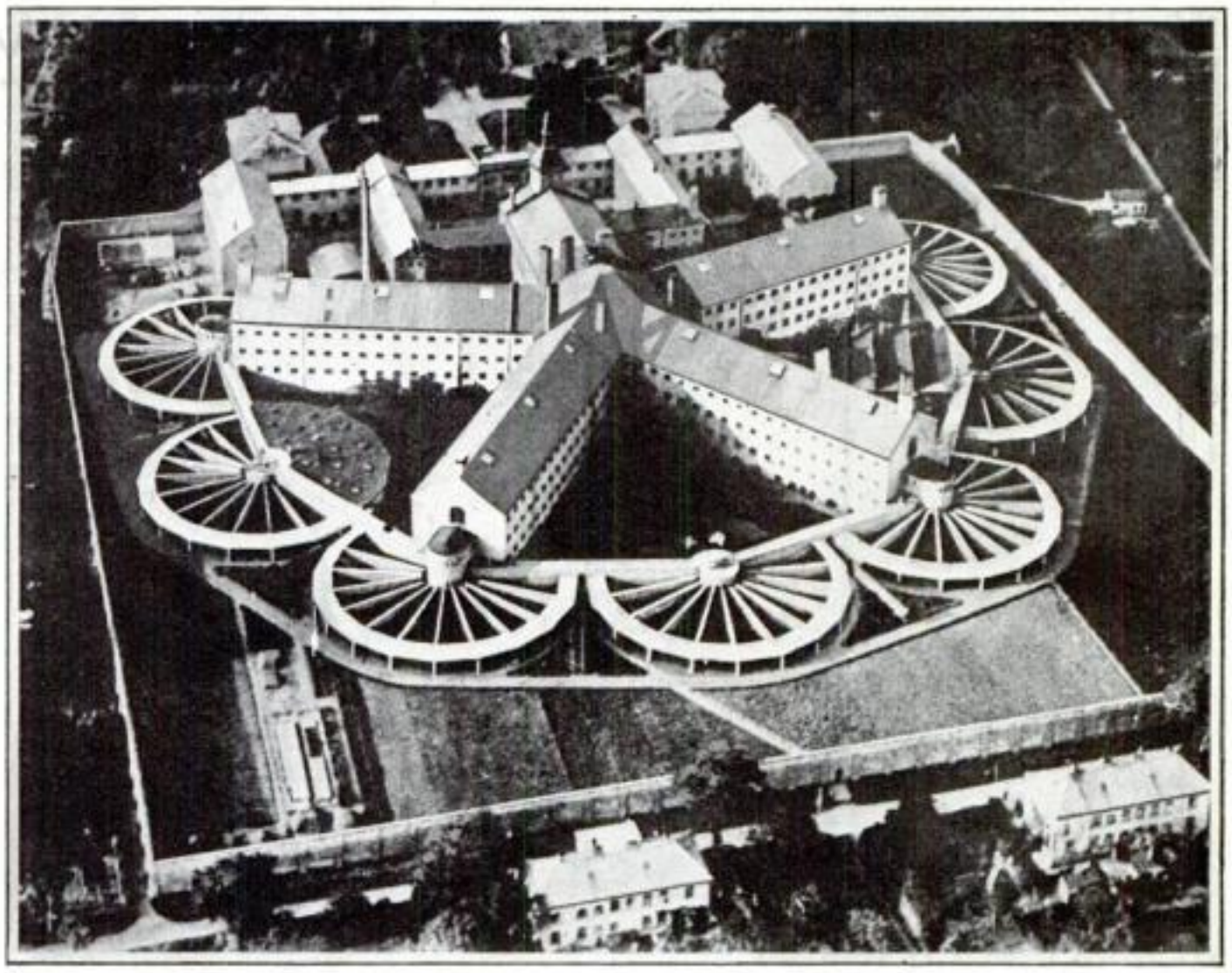
CHAIR HAS ROOM FOR DOG AND MAN

A MAN and his dog share the use of a "pet chair," a recent innovation in furniture for the homes of animal lovers. The top of this chair and its seat resemble any other. But the chair's bottom is a compartment that provides a home for the household pet, and shields it from drafts. There are several styles of "pet chairs" to harmonize with any collection of furniture. Another novelty is a small settee, with a hollow interior for a cat.

SEEN FROM AIR, PRISON LOOKS LIKE WAGON WHEELS

From an airplane, an odd prison in Copenhagen, Denmark, bears a striking resemblance to a group of large wagon wheels lying on the ground. A number of circular structures built around the main prison buildings have walls extending from their rims to central points like spokes in wagon wheels. The spaces inclosed by the walls are exercise yards for convicts.

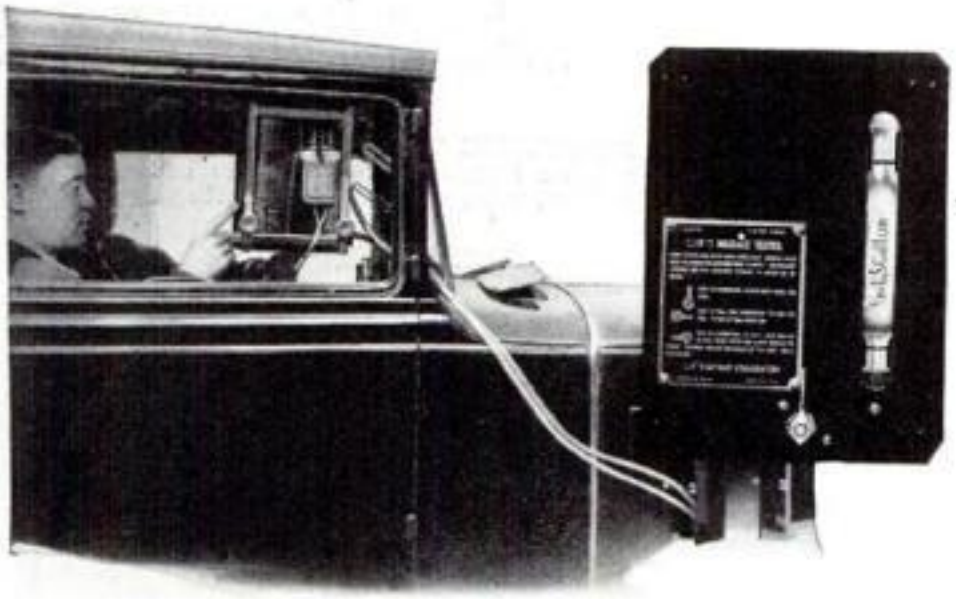
Separating convicts into small groups, Danish prison authorities believe, lessens the possibility of their plotting mutinies or jailbreaks. Not only are they separated, but they are more easily watched.



Photograph taken from an airplane of an unusually designed prison at Copenhagen, Denmark. It looks like a group of wheels lying on the ground. The spokes are walls that divide the recreation ground.

CAR TIRE NOW AIR-COOLED

An automobile tire that inhales and exhales air through rows of pores in its outer tread is a new invention. This air-cooling is said to remove the internal heat generated by high-speed driving, lessening the chance of a blow-out and making possible a thicker and longer-wearing tread. Air is circulated by the tire's flexing.

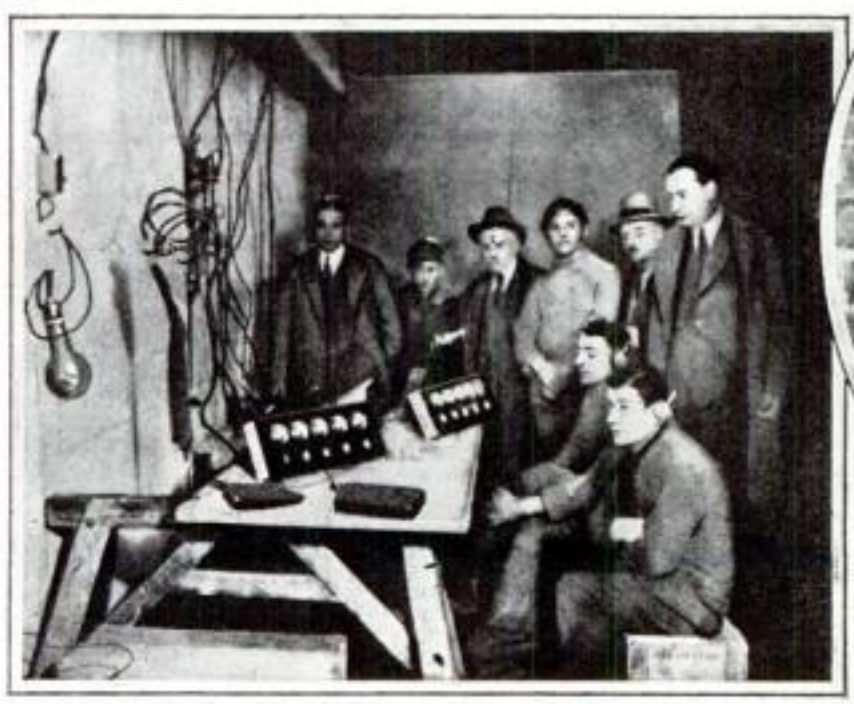


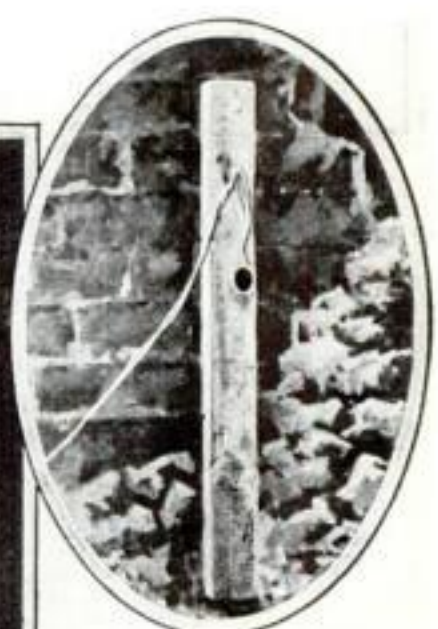
GAGE SHOWS GAS CAR USES

A new device hung on a car's right door settles the often-disputed question of how many miles its owner gets from a gallon of gasoline. This portable instrument board contains a small glass bulb holding exactly one tenth of a gallon, a three-way cock, and a small electric pump. It is connected to its engine's gas feed system by rubber tubing. As soon as the road becomes clear enough for a test—about three miles should do—the handle of the three-way cock is turned to the test position. When the fuel passes the upper graduation in the glass tube the trip mileage is read on the speedometer. As it passes the lower mark the speedometer is read again. The distance covered, multiplied by ten, is a close approximation of the distance the car will travel on a gallon of gasoline.

RIG UP MIKE TO WARN OF LANDSLIDE

Recent landslides in France, one of which killed a General of the U. S. Marines, lend interest to a hitherto untold story of quick-witted action. When a landslide spread death among the inhabitants of Lyon, France, a few months ago, radio amateurs of that city rigged up an apparatus within a few hours to give advance warning of further earth slips. They hurriedly installed eight microphones on the slopes of hills overlooking the town's buildings. Wires led from the microphones to a central observing post in a small garage. Here volunteers took turns on watch before electric dials. A small movement of a needle on one of these dials would show that the microphone had picked up the vibration of moving earth. In the event of a landslide, the alarm would be spread by phone to occupants of endangered buildings.





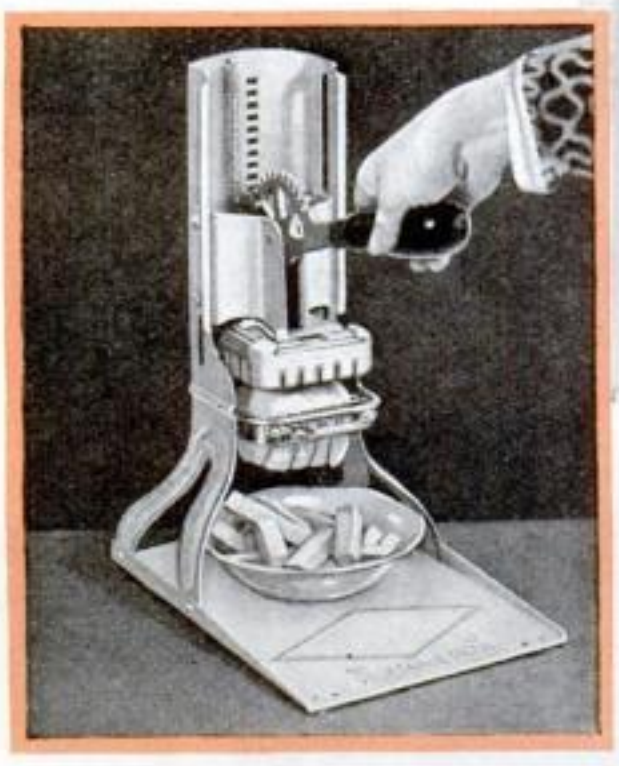
At left, dials in a garage connected with microphones on distant hills, to warn watchers of impending landslide at Lyon, France. Above, one of the mikes to catch vibrations.

Latest Inventions for the Household

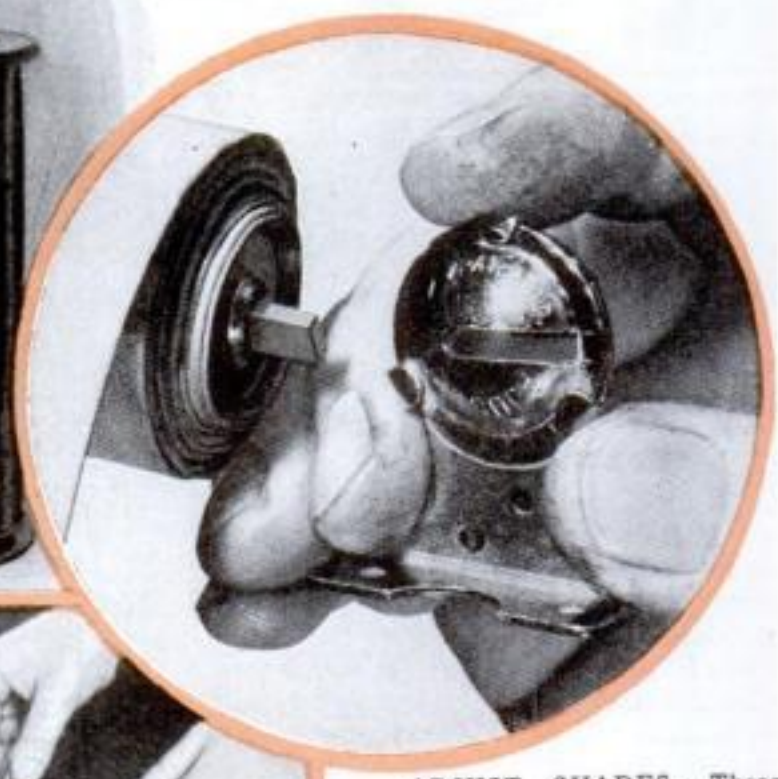
ORANGE JUICE WITH EASE. Half an orange, tucked away inside this extractor, gives up its juice quickly when the aluminum holder is lowered and a few turns given to the hand crank.

THIS WINDOW SWINGS IN. Set in a sash that is hinged at the sides to open into the room, this novel window is easily cleaned, as both sashes come within convenient reach.

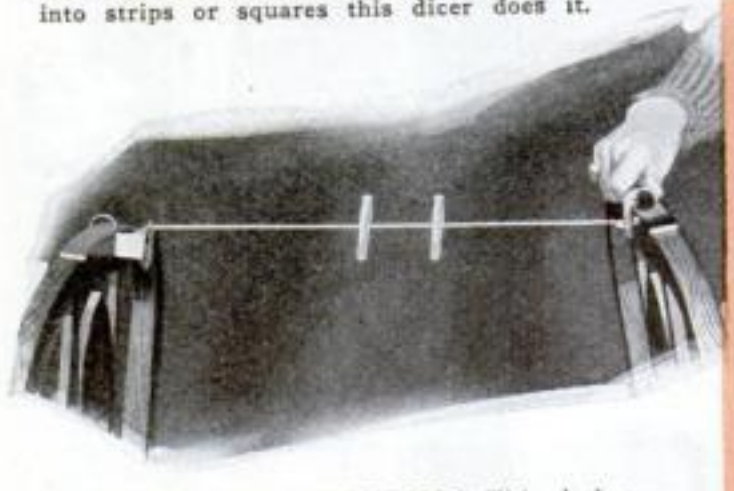
NO REFUSE THROWN AWAY. At left, an incinerator burns papers and rubbish, using the heat to dry garbage.



SLICES YOUR VEGETABLES. If you want to cut turnips, carrots, or potatoes into strips or squares this dicer does it.



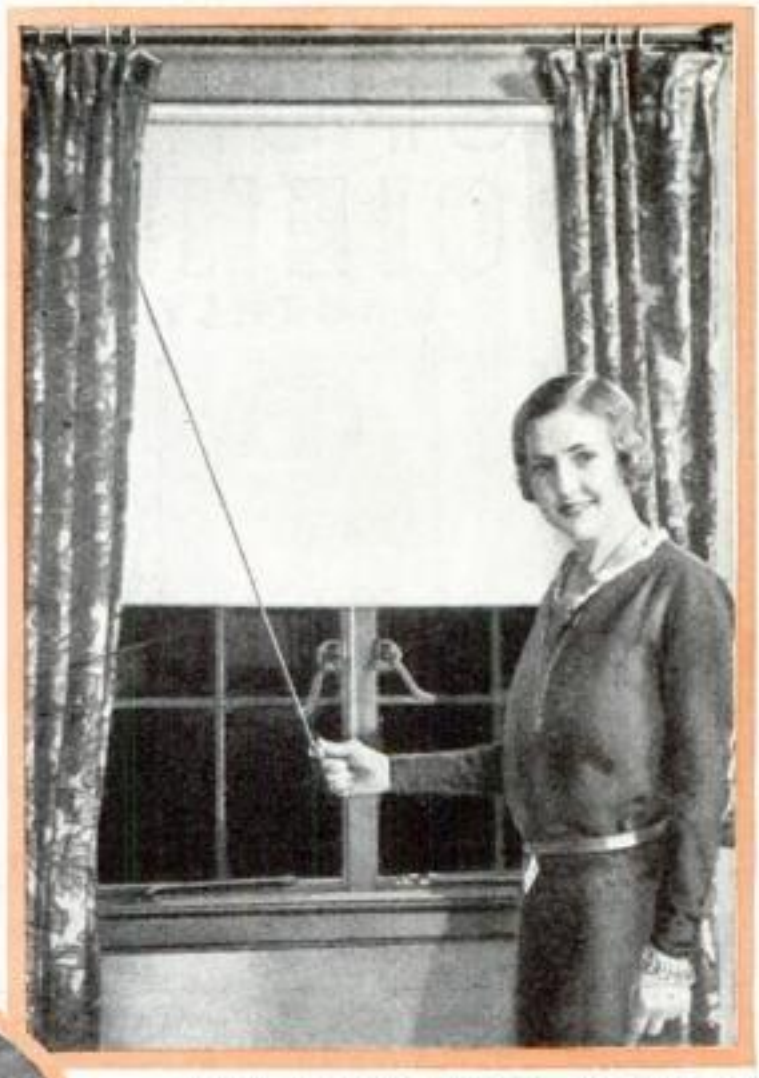
ADJUST SHADES. These brackets, shown above, permit you to fix a window shade while it is still in place. Spring notches set the shade at any height which is desired.



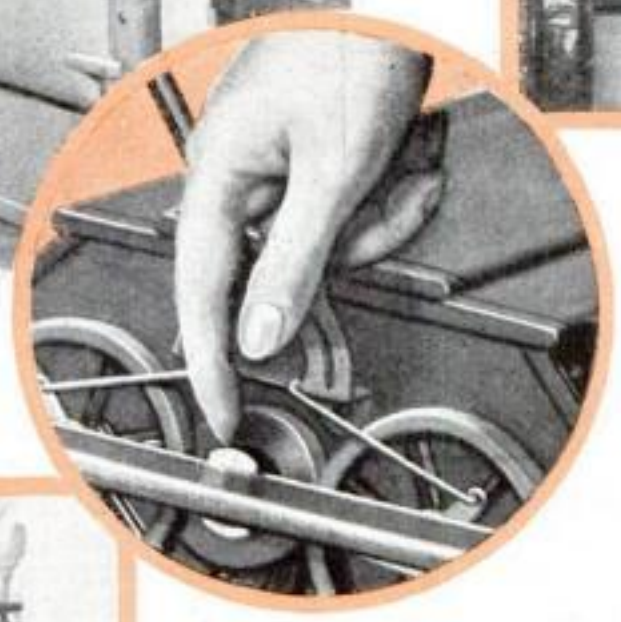
CLOTHESLINE FOR TOURISTS. This clothesline, designed especially for travelers, attaches with metal clips to the back of any handy chair. It comes in a kit with tiny clothespins and a reel.

STRAINER ON A STAND. Complete with its own stand, this vegetable and fruit strainer, left, is designed to do duty in taking the lumps out of food. The stand is strong and folds.

STOVE STORES ITS HEAT. Built like a fireless cooker, this new coke-burning range has a large metal block in which the heat is stored. Covered with lids the heat is held so that the stove is always ready for cooking.



CORD RAISES SHADE. Grabbing the shade and having it slip out of your hand is impossible if one of these cord adjustments is used. Just a pull on the cord raises the shade to any desired height and holds it there without the use of a spring. The shade is drawn down by hand like ordinary kind.



SET YOUR BRUSHES. A new type carpet sweeper has a brush control for heavy or thin carpets.

PUSH BUTTON FOR HEAT. Steam radiators can be turned on or off by pressing a button exactly as an electric light is worked. An electromagnet holds a steel ball out of the way while current is on. Shutting off current closes the valve.

TURNS WASHBOWL INTO A TUB. This portable clothes washer can be used with ease in any hand bowl. A plunger forces the soapsuds through the garments laid beneath it.

VERSATILE CASSEROLE. Made of heat resisting glass, the casserole at right is more than its name indicates. On the inverted lid, cakes can be baked or hot dish placed.

BOON TO GRAVY MAKERS. Built like tongs, this flour sifter is filled by dipping it in the flour bin and pressing the handles together. Releasing the pressure opens it.

POPULAR SCIENCE MONTHLY

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The Joy of Hobby Riding

CONSIDER the people you know and you will find, almost without exception, that the ones who take the keenest interest in living, who are least subject to mental depression, and who get the most out of life are those who take an intense interest in some hobby.

It makes not the slightest difference what the hobby may be. Whether it is collecting old bottles, mountain climbing, making things in a home workshop, photography, or modelling in clay, the beneficial effect on the mental processes and physical equipment is equally good.

A man we know, head of the research department of one of our largest electrical manufacturing firms, has spent much of his spare time for many years studying the life and habits of turtles. His working hours are filled with abstruse research problems in electricity, physics, and chemistry. His play hours are spent in a highly specialized branch of nature study. It is conceivable that some day he will discover some fact about turtles that may prove useful in his daily research work. That possibility is, however, extremely remote.

Although he has become one of the greatest living authorities on the habits of turtles, he is not likely, in any direct way, to cash in on that knowledge. He studies turtles because they happen to interest him.

Yet no one will ever know just how many of the brilliant ideas that have been hatched in this man's mind are due to the brain clearing effect of a really interesting hobby.

Just what is a hobby, anyhow? Reduced to its simplest terms a hobby is something that a man does because he wants to do it and without any thought of financial return. Of course it is sometimes difficult to differentiate between vocation, which is just a high-brow name for work, and avocation, which is the equally high-brow name for hobby.

SOME men make a hobby of their work. That, in most cases, is bad for the man. There is a lot of truth in the old saw: "All work and no play makes Jack a dull boy." Other men become so absorbed in their hobbies that they neglect their work. When a man lets that happen it is only a question of time when he'll find himself out of a job.

Sometimes a man is lucky enough to find interest in a hobby that is more or less indirectly related to his work. For example, we know a prominent publisher of trade magazines dealing with furniture and decorations who is a keen antiquarian. The sight of a piece of furniture built more than a hundred years ago gives him a genuine thrill. The connection between vocation and avocation is quite obvious.

Another man, advertising manager for the magazine you are reading at this moment, is a home workshop enthusiast. His shop boasts most elaborate woodworking equipment. He builds ship models, furniture, and similar things. When he talks to an advertiser of tools and how to advertise them he is on ground familiar through personal experience.

THEN there is the head of the research laboratory of the largest optical works in this country. When he stopped at our office some time ago we chanced to ask him what time it was. He was well equipped to answer that question, for he had on his person, stowed away in various pockets, seven different watches, some of them historical pieces worth many hundreds of dollars as antiques. The look of keen enthusiasm that crept over his face as he went into the details of his hobby was good to see. Lenses and watches are both instruments of rare precision. So there is a connection between this man's work and his hobby. Incidentally, he has become such an expert on timepieces that the jewelers and watchmakers in his own city call on him when they run into a particularly knotty problem.

As a general rule, however, the farther a man's hobby is removed from his daily work, the greater the mental relaxation and stimulation he gets out of it. That is why it is natural for a man who works with his head in the daytime often to spend his evenings at a hobby involving manual labor, while the man who has to use his hands all day in a skilled trade desires a hobby that depends chiefly on mental effort. Gene Tunney is an extreme example of the latter class. He socked jaws for a living and soaked up Shakespeare for amusement. A college professor who went in for amateur boxing or similar strenuous athletics would be an instance of the reverse situation.

Many men go on the principle that if one hobby is good, two or more will be better. There is good sense in this idea especially if the chosen hobbies are seasonal.

A lawyer we know plays golf all summer during his spare time. Then when cold weather sets in, he oils his clubs, puts them away, and spends his winter evenings building fancy violins and other musical instruments in his home workshop.

ANOTHER man, an accountant, works the same combination except that his summertime hobby is gardening and in winter he makes copies of old furniture. From the specimens we have examined, he has attained a degree of skill in woodwork that would have made some of the old-timers blush with shame.

In fact it often happens that the amateur craftsman produces a finished job that is better than the factory built article. The obvious reason is that the amateur is really interested in developing skill in craftsmanship. He is not handicapped by the necessity for getting the job done in a hurry. And what he lacks in manual deftness, he can more than make up for by the patience needed to make a part over and over.

We could go on and on for many pages detailing examples of men who have found hobbies that contrast in most amazing manner with their daytime occupations. POPULAR SCIENCE MONTHLY numbers among its readers many men who have hobbies that they pursue with whole-hearted enthusiasm. Perhaps that is why POPULAR SCIENCE MONTHLY readers take such a notably keen, inquiring interest in life and in the science that makes life more livable.

Science Baffles the Crook

WHENEVER the manufacturers come out with a new kind of unpuncturable armor plate, the gun makers get busy and produce a gun that will punch a hole in it.

The race between offense and defense has been going on since the beginning of time, and doubtless will continue until there is nothing left to attack or defend.

The fascinating series of articles now running in POPULAR SCIENCE MONTHLY (see page thirteen) shows how society's arm of defense, the police, is bringing the latest discoveries of science to aid in the constant warfare against crime. So long as human nature is fallible crimes will be committed and it will be necessary to have police to apprehend the criminal or prevent him from doing the job.

As time goes on criminals become more and more expert. It is comforting to think that science will continue to keep the police one jump ahead of the criminal. No matter how expert he becomes, science will always remain our strongest bulwark of defense.

HELPFUL HINTS FOR RADIO FANS

Secret of Shielding Your Circuit

Interference between Stages That Causes Squeals Stopped by Solid Wall of Metal—Disconnecting Speaker Wires All at Once

Fig. 1. Pronged unit and socket and, right, pronged connector, used to join many wires.

THERE are many occasions when the amateur radio experimenter needs a method of disconnecting a number of wires at one time. The modern dynamic loudspeaker requires four connections, two for the field supply and two for the voice coil or to the primary of the voice coil transformer.

In experimental work, it is desirable to be able to connect and disconnect the power supply wiring without resorting to the soldering iron or loosening several binding posts.

The three units shown in Fig. 1 will prove especially useful along these lines. The two units shown in the hand are the two sections of a cord connector that joins five wires. The prongs on the right-hand section are exactly the same as the prongs on the base of a type 227 or 224 tube. The socket portion of the connector would, therefore, receive the base prongs of either of these tubes and could be used on various homemade testing equipment.

At the bottom of Fig. 1 is shown a pronged connector fitting to be attached to the radio receiver. The socket portion of the connector fits over this and will make connections to five terminals of the receiver with one motion. Both sections of the cord connector shown in the hand come apart by means of a bayonet lock exposing soldering lugs such as appear on the set fitting.

RULES FOR SHIELDING

Beginners in radio often are puzzled as to why certain radio circuits seem to require such careful shielding while others need almost none.

The answer can be found in a study of the circuits. Generally speaking, wherever there are more than two tuned circuits, shielding is necessary for high efficiency. Of course it is possible to build a multi-stage receiver that will work satisfactorily with almost no shielding, but this can be done only by deliberately reducing the efficiency of each individual stage to the point where interference between stages cannot cause a "spill-over" and start a squealing noise.

The function of shielding is to prevent interaction between the various amplifying stages of the circuit. This interaction can be caused by capacity coupling, which means that the parts of the adjacent circuits act to each as do the plates of a condenser and actually allow a flow of high frequency current from one stage to the other in a way that will cause trouble. The other type of coupling is electromagnetic and is the effect you get when two coils are placed near each other.

In radio-frequency stages, capacity coupling can be eliminated by placing between the parts which might interact a sheet of metal that is connected to ground. Instead of there being a capacity between the parts of the two circuits in such a case, the capacity between each set of parts is to the grounded shield.

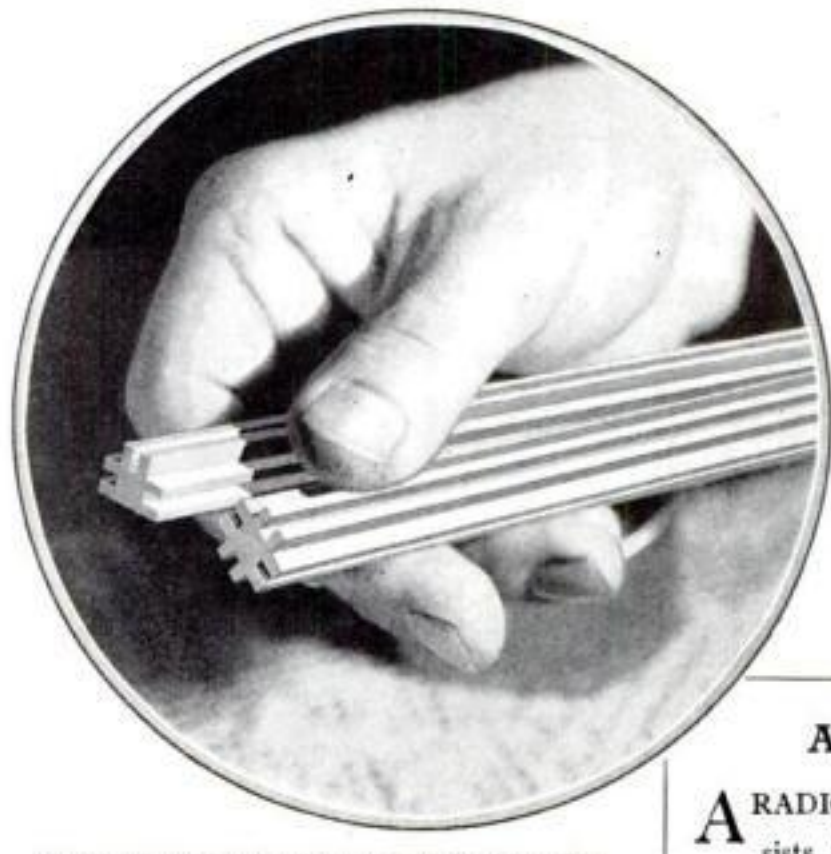


Fig. 2. Grooved aluminum stock to form the corners of adjacent cans in your shielding.

The thickness of material used for capacity shielding is of trifling importance. In most cases a sheet of tinfoil makes as good a capacity shield as heavy copper plate.

Electromagnetic shielding, on the other hand, depends to a noticeable extent on the thickness and electrical conductivity of the metal. The ideal material, judged solely on its effectiveness as an electromagnetic shield, is iron. However, the fact that iron has magnetic qualities makes it unfit for use as a shield for tuning coils.

Generally speaking, the higher the amplification obtainable at radio frequencies, the more need there is for effective shielding. Effectiveness is governed not only by the thickness and kind of material but also by its completeness. The most effective shield is a solid wall of metal completely surrounding the coil or other part that is to be shielded. In theory, the wall of metal should be continuous without joints of any kind. In practice this is impossible, as there is no way of making connections to the shielded part. However, it is desirable to conform to the theory as far as practical by avoiding large holes or open seams. Aluminum is much used for shielding. Its electrical characteristics are excellent for this service. It is not practical to solder seams in this material. The next best thing is to make them overlapping, and Fig. 2 shows two new forms of grooved aluminum stock that is especially useful to the radio experimenter. Aluminum strip with two grooves set at right angles has been available for some time to join the edges of two pieces of heavy sheet stock at right angles.

The new forms have three or four grooves to join adjacent cans.

A B C'S of Radio

A RADIO receiver as built today consists of a chassis, a loudspeaker, and a cabinet. The chassis will, of course, function just as well without the cabinet, but that is not true of the loudspeaker. The cabinet really is part of the loudspeaker. It forms the baffle board that makes low notes possible. The larger the cabinet, other things being equal, the lower will be the notes the loudspeaker can reproduce. Aside from this important point, it pays to buy a substantial, strongly built cabinet.

AN EASY-TO-BUILD

Short Wave Converter

By LEWIS WINNER

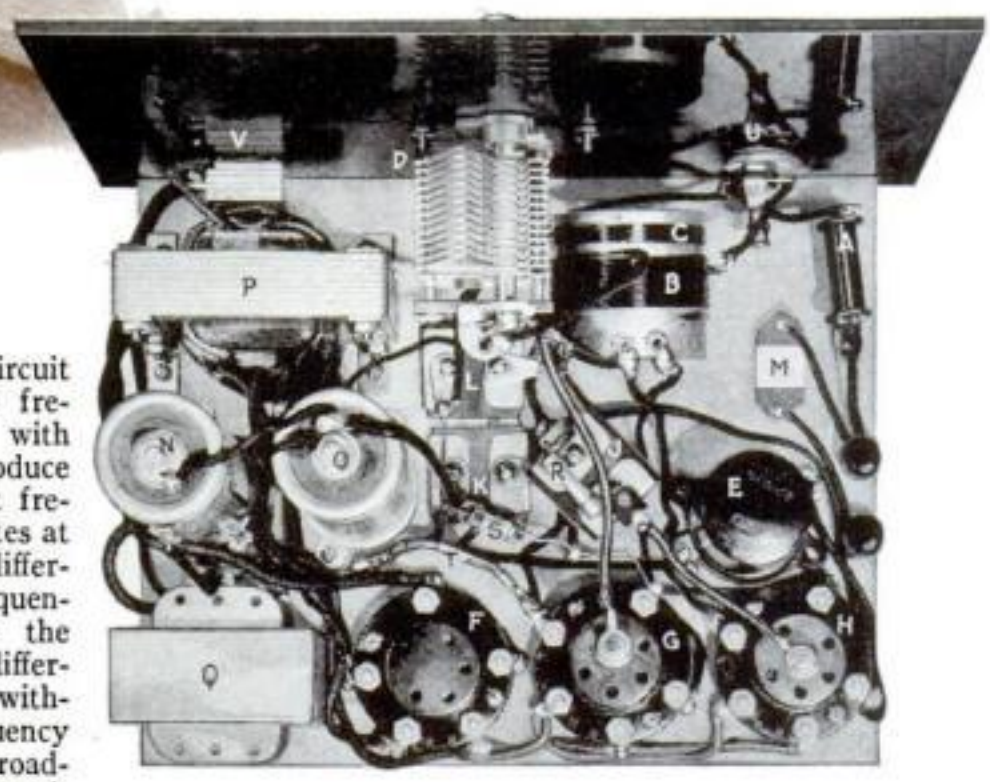


Fig. 1. Upper left, Lewis Winner, with the short wave converter unit, top and back views of which are shown above.

THIS superheterodyne short wave converter unit has several features that will appeal to the amateur radio experimenter. To begin with, it is cheaper to build, I think, than any similar circuit so far developed.

The unit makes use of three radio tubes, one type 227 and two type 224 screen grid A. C. tubes. When you have built it you have only to connect your regular broadcast antenna to the proper binding post, run a wire from the antenna binding post of your broadcast receiver to the binding post provided for that purpose on the converter unit, plug the cord from the converter unit into the nearest socket, and turn the dial for short wave stations.

The short wave signals coming down the antenna in this unit are picked up by the tube in socket *H*. This tube, being operated in an untuned circuit, treats all signals alike and consequently produces in the plate circuit of the tube all of the signals in rectified condition. The tube in socket *G*, the oscillator tube, is in a continuous state of oscillation, which is controlled by tuning the circuit consisting of coil *B* and condenser *D*.

When this condenser is set so that the oscillations of tube *G* are close in frequency to the oscillating radio waves flowing in the plate circuit of tube *H*, the two frequencies interfere with each other and produce what is called a beat frequency, which oscillates at a rate equal to the difference of the two frequencies. By adjusting the condenser *D*, the difference can be brought within the broadcast frequency band to which the broadcast receiver is tuned. When that happens this beat frequency is amplified by the broadcast set and the short wave station is heard from the loudspeaker.

ALL that is necessary to get this result is to have the broadcast receiver tuned to some frequency in the broadcast band that is relatively silent on regular broadcasting. Experimenting will soon show you what broadcast setting is best for your set in your locality.

A word of warning: don't waste time building this short wave converter unit unless you have a modern broadcast receiver that is fitted with at least two, and preferably three, screen grid tubes. The short wave converter unit does not amplify short wave signals; it converts them into a form that can be amplified by your regular broadcast set, and if the broadcast set lacks the degree of radio-frequency amplification in modern screen grid sets no worth while results can be obtained.

To build this converter unit you will need the following parts:

A—special radio-frequency choke coil.

B and *C*—combination oscillator tuning and coupling coil.

D—variable condenser, capacity .0002 mfd.

E—radio-frequency choke coil, 85 millihenries.

F, *G* and *H*—standard Y-type five-prong tube sockets.

POPULAR SCIENCE MONTHLY Blueprint No. 137, price 25 cents (see list on page 91), describes in great detail the construction of this set. A list of parts approved by the Popular Science Institute is included with each blueprint. This list also will be mailed without charge to readers who wish to work from this article without ordering the blueprint. Address Technical Editor, Popular Science Monthly, 381 Fourth Ave., New York.

YOUR modern screen grid broadcast receiver can be easily converted into a short wave unit that will give you satisfaction if you follow the few simple directions for an original circuit which are given in this unusual radio article.

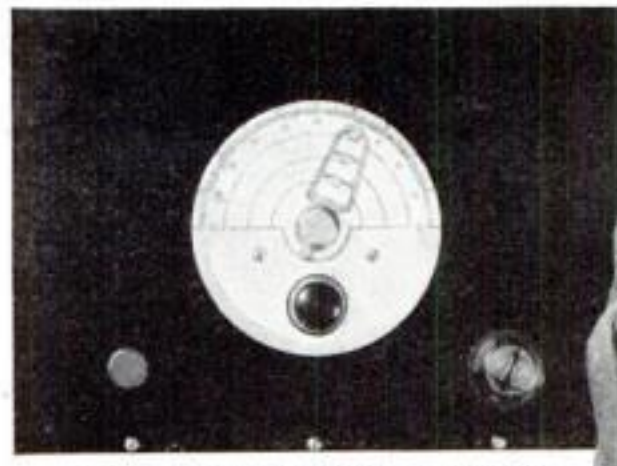


Fig. 3. A view of the panel with the dial for short wave set in position.

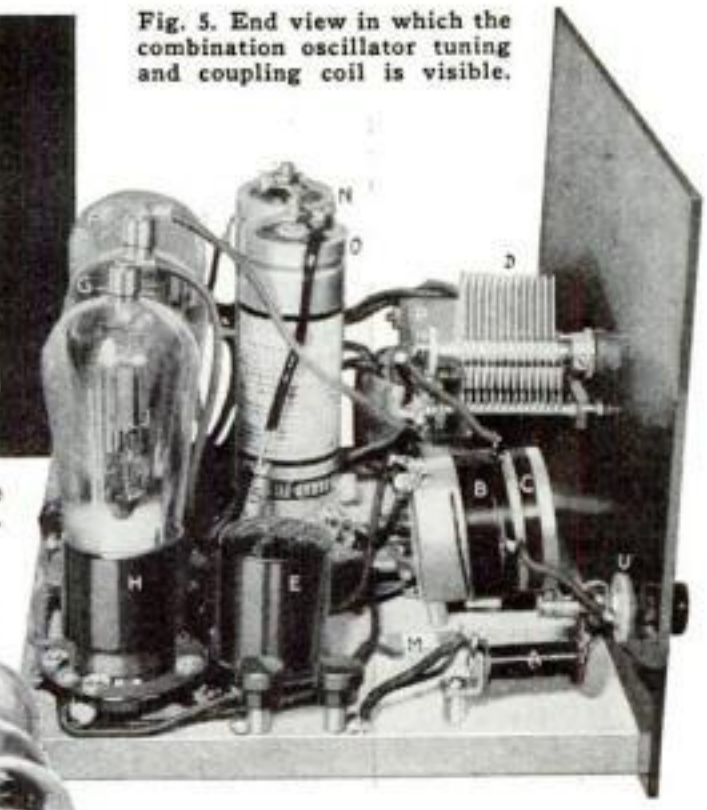
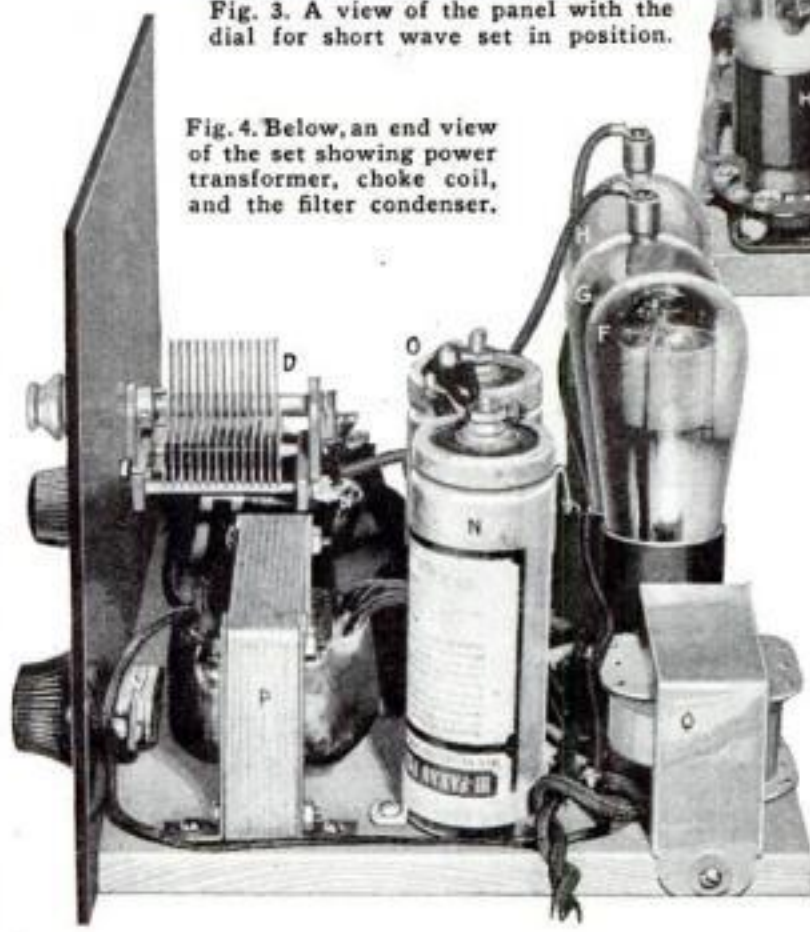


Fig. 5. End view in which the combination oscillator tuning and coupling coil is visible.

Fig. 4. Below, an end view of the set showing power transformer, choke coil, and the filter condenser.



J—grid condenser, .00025 mfd.
K—fixed condenser, .1 mfd.
L—fixed condenser, .2 mfd.
M—fixed condenser, .00035 mfd.
N and *O*—electrolytic condenser units, 8 mfds. each.
P—step down transformer capable of handling three 2½-volt tubes.
Q—choke coil, 30 henries inductance.
R—grid leak (20,000 ohm small tubular fixed resistance).
S—fixed resistance, 20,000 ohms (same as *R*).
T—fixed resistance, 150 ohms.
U—small battery type panel switch.
V—small panel type 110-volt switch.

YOU probably have on hand some parts that can be used. It is, however, important that all of the resistance and condenser units be of the values specified.

The radio-frequency choke coil *A* can be wound at home. It consists of 125 turns of No. 38 enameled wire on a wood or cardboard form three eighths inch in diameter.

The combination tuning and coupling unit *B* and *C* will have to be made at home. So far as I know, there is no commercially wound coil now on the market that will meet the exact specifications given.

Coil *B* consists of fourteen turns of No. 18 enameled wire (cotton or silk covered would do just as well) tapped at the second and fifth turn. The end of this coil should be approximately one eighth of an inch from coil *C* which consists of sixteen turns of No. 28 enameled wire (you can use cotton or silk covered if desired).

AS YOU will note from the picture wiring diagram of Fig. 2, the end of coil *B* nearest to coil *C* is connected to the cathode of tube *H*. The tap at the second turn is connected to the rotary plates of condenser *D*. The tap at the fifth turn is connected to switch *U*, and the other end of the coil is connected to the stationary plates of condenser *D*.

In this circuit the *B* supply is obtained by taking the 110-volt alternating current from the wall socket and rectifying it with the 227 tube. The method is exactly like that used in the Headphone Electric Set (P. S. M., April '31, p. 83).

I found, however, that the small one-microfarad condensers used in the filter circuit of the Headphone Electric Set, although they worked nicely in that outfit, did not give sufficient filtering action in the converter unit. This is because one of the tubes in the converter unit is in a constant state of oscillation, which builds up any hum that may be present. That explains why I used eight-microfarad electrolytic condensers at *N* and *O*.

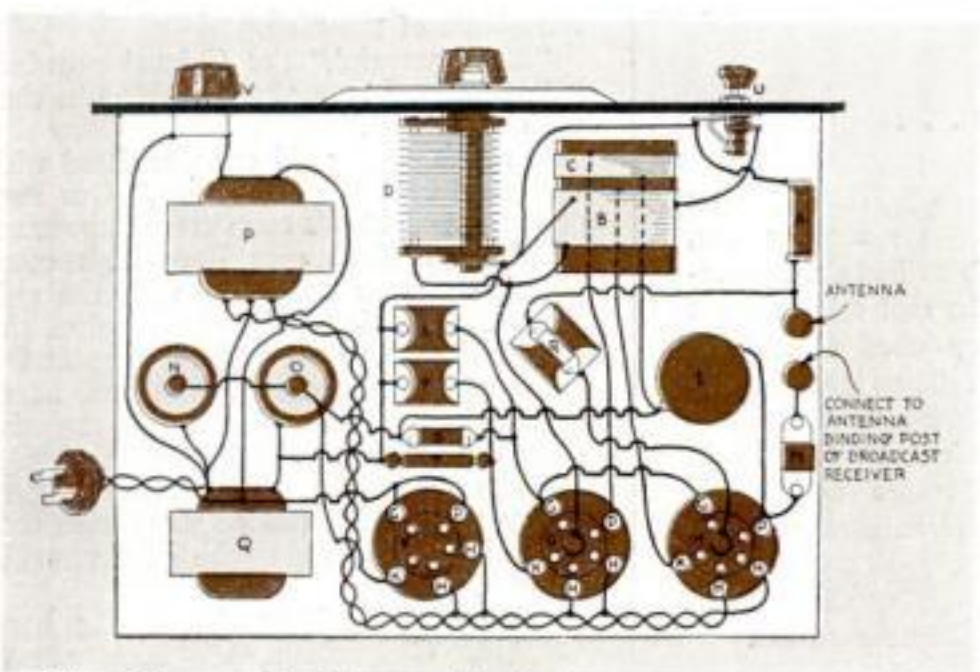


Fig. 2. Picture wiring diagram of simple short wave converter, showing the connection to be made and the position of the various parts.

A SMALL, 30-henry choke coil is used at *Q*. Equally good results could be obtained from any old audio transformer you may have, making connection to the secondary terminals, *G* and *F*; assuming, of course, that the audio transformer is in good working order.

You can use any suitable nonconducting material for both the baseboard and the panel. Do not use metal for either.

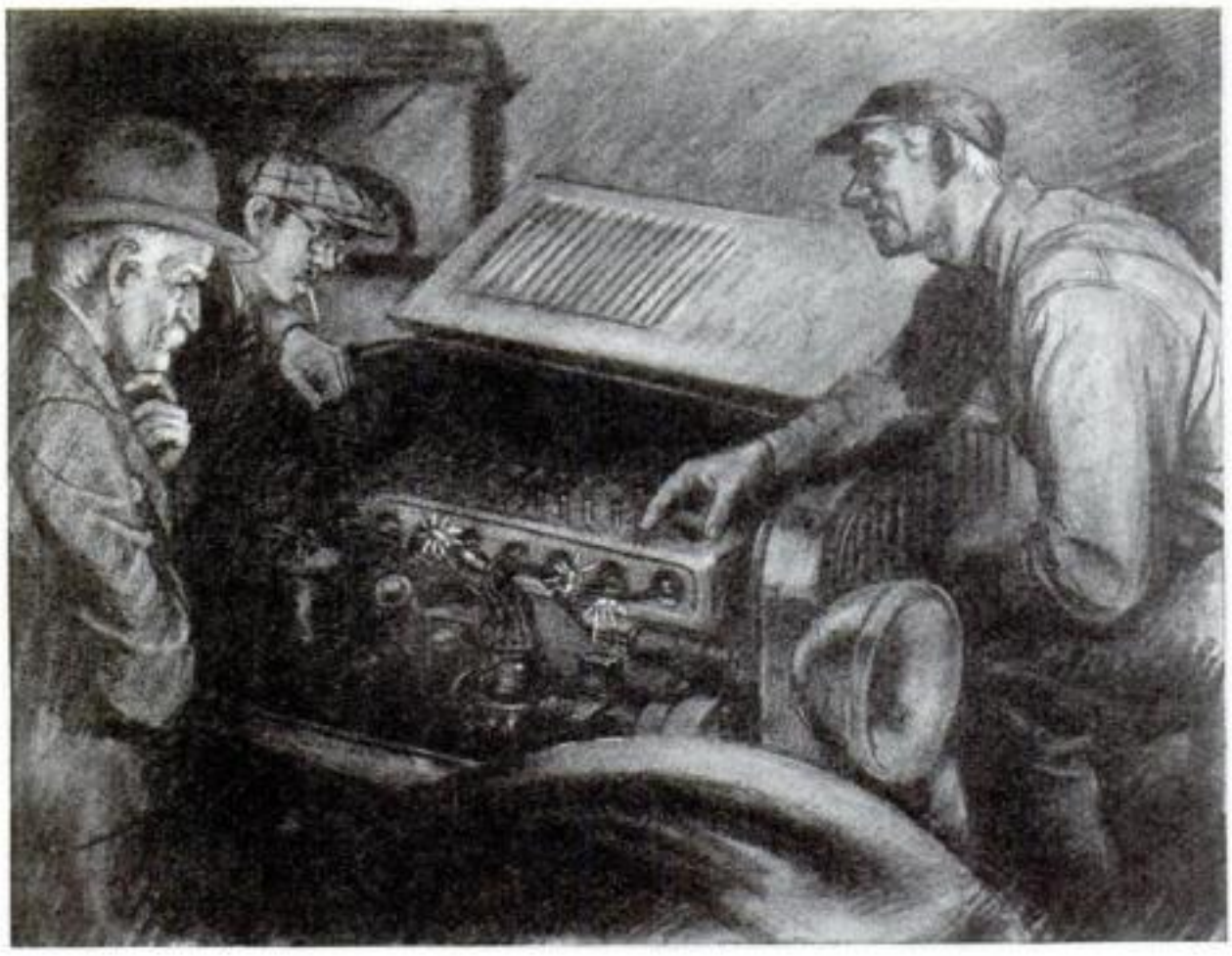
Before you start to cut your baseboard, carefully study all the illustrations, particularly the wiring diagrams. Lay out the parts in approximately the arrangement shown in the top view and back view, Fig. 1, and the end views Figs. 4 and 5. The panel shown measures 7 by 10 inches and the baseboard 7 by 9. It is not necessary to stick to these dimensions. You may find it easier to make the panel and baseboard a bit wider to facilitate wiring.

After all the parts are assembled, start the wiring with the filament heating circuit. The 2½-volt filament heating transformer *P* should have a center tap on the 2½-volt secondary winding and this center tap is connected, as shown in Fig. 2, the picture wiring diagram, with the side of the power line that is connected to the *G* and *P* terminals of socket *F*. The terminals of the 2½-volt winding are connected by means of a twisted cord to the binding posts marked *H* and *H* of sockets *F*, *G*, and *H*. Note that the sockets are connected in parallel so that each receives the full 2½ volts.

Proceed with the rest of the wiring. Make each wire as short and direct as possible. Note that the cap connections for the screen grid tubes in sockets *H* and *G* should be of flexible wire. Radio dealers can supply suitable caps or you can make a loop in the bared ends of the wires.

Do not consider the wiring job complete until you *(Continued on page 111)*

By
MARTIN
BUNN



"Your spark plug wiring is shot," Gus explained. "It's leaking like a sieve, and wherever wires touch metal current snaps through."

How to Spot Ignition Trouble

Modern Motors Throw Strain on Spark Plugs and High Tension Wires So Good Cables Are Needed—Setting Timer Simple in Eight-Cylinder Car

ONE sizzling hot summer evening, while Gus Wilson and Joe Clark were working late on a rush job, a year-old eight-cylinder sedan drew up in front of the Model Garage and the owner climbed out.

"Howdy, gentlemen," he drawled as he strolled over to the garagemen. "I see you-all are still making hay though the sun is down. Could I impose on your good nature long enough to have you look over my motor?"

"Be with you in a jiffy, Colonel Marrold," Gus replied as he finished tightening a bolt and reached for a clean piece of waste. "What seems to be the trouble?"

The Colonel's brow wrinkled in a puzzled frown as he twisted the end of his snow-white mustache. "I can show you what it does," he said, "but I haven't any notion of what's wrong. Old Betsy, that was my old car, Suh, couldn't fool me with her whims; but this newfangled youngster has me guessing for sure."

Gus smiled, for Colonel Marrold at the wheel of old "Betsy," a huge six-cylinder bus of ancient vintage, had been a familiar sight around that section for many years.

"I had it all figured out it was dirt in the carburetor," Colonel Marrold continued as he climbed in and prepared to start the motor. "The pesky engine misses fire as old Betsy did when something got in the carburetor. I cleaned it twice and that didn't do any good. So then I cleaned all the spark plugs and touched up the breaker points. That used to make old Betsy run like a thoroughbred."

The Colonel stepped on the starter pedal and the motor, being warm, started at once, but it did not settle down to a steady purr. The cylinders missed fire irregularly and there was a peculiar roughness in the way it ran.

"Runs sort of shiftless," Colonel Marrold complained. "Kind of like a row of soldiers, some of 'em stumbling and not keeping in line. Only if it was soldiers, Suh, I could have the top sergeant take 'em in hand!"

"You've hit the nail on the head without knowing it, Colonel," said Gus as he reached over and pulled the switch that cut off all the lights outside the garage.

"Look at that," he added, raising the hood of the car on the distributor side.

In the dim light from the street lamp some distance away, the space under the hood looked like a chunk of utter blackness in the general gloom. Here and there tiny sparks flashed at irregular intervals and each flash was accompanied by a sharp but faint snap that was barely audible above the hum of the motor.

"THUNDERING gunboats!" exclaimed the Colonel in amazement. "What in tarnation is going on there?"

Gus snapped on the lights. "Your spark plug wiring is shot," he said. "It's leaking like a sieve, and wherever one of the wires touches metal, the current snaps through for a spark instead of jumping the points of the plug."

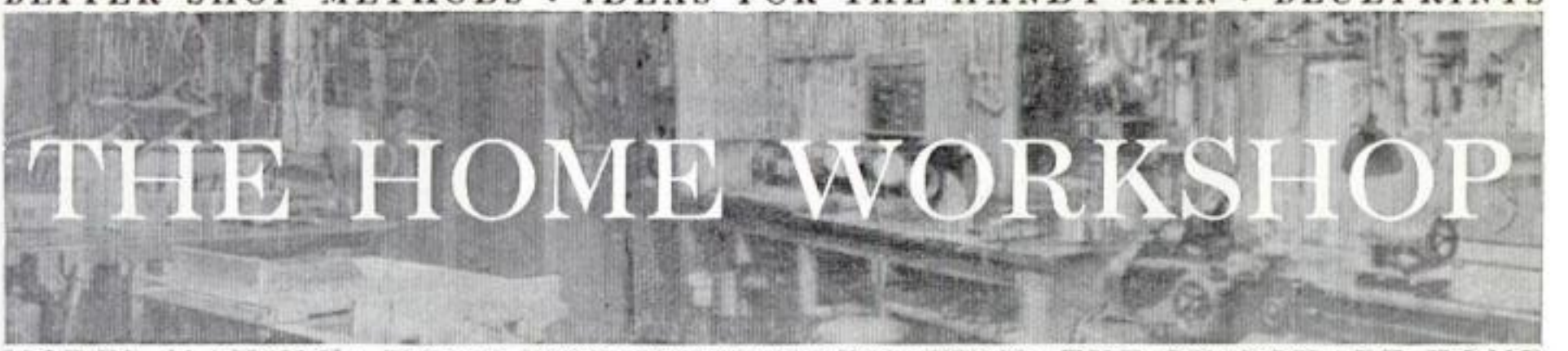
"Most amazin'," the Colonel growled. "It's strange I never had trouble like that with old Betsy."

"Probably your old car was fitted with better wire in the first place," Gus suggested. "And what's even more important, all these modern cars have high compression motors compared with the old-timers. The higher the compression, the harder it is for the spark to jump at the spark plug points and sometimes, as in this case, the rubber covering on the wire dries out and cracks and the spark jumps through the cracks. It isn't anything to worry about. I'll put in some high tension wire that will keep the juice where it belongs.

"There's something else wrong here, Colonel," Gus continued. "It sounds to me as though the timer is out of synchronism." *(Continued on page 111)*

GUS Says . . .

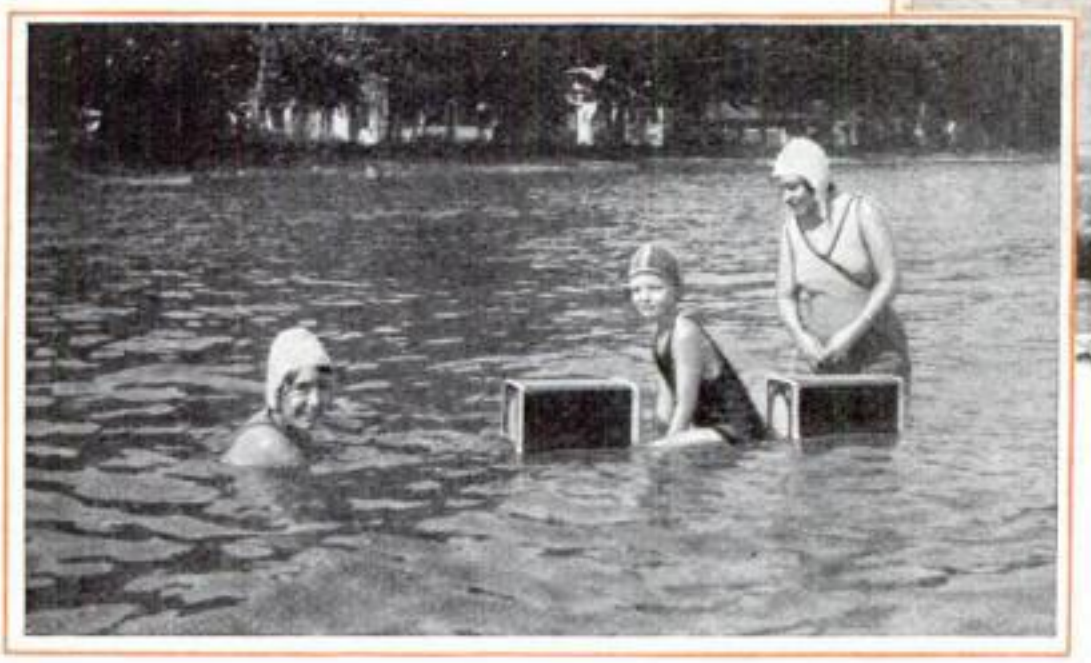
WHEN you get a new car, your first job is to find the instruction book in the tool compartment and read every word of it from cover to cover. Then take the oiling chart and tack it to the wall of your garage so it won't get lost. It makes no difference how many years you've driven cars, the new one is bound to have some things that are different in the way you work 'em or take care of 'em.



Bucking Sea Broncho Gives Wild Sport

By HARRY E. WOOD, JR.

The sea horse has a tame and gentle look, but just try to ride him! How he can buck!



THIS strange sea horse provides the thrills of broncho-busting — with a ducking to penalize every slip! It's a nautical nag upon which as many as five small water riders may get astride at one time, yet it is made of nothing more than an old board and a pair of large, empty cans.

The body is of ¾ in. thick white pine or other durable wood. Cut it to the shape shown and round the edges with a wood rasp and sandpaper.

For the lungs of the horse, obtain two 5-gal. tin cans, preferably square on the ends, and solder the opening in the top of each to make it air-tight. Eight strips of heavy tin or galvanized iron, 1½ by 6 in., are then snipped out of any scrap material, and a ¼-in. hem is folded lengthwise down each side of each piece. This leaves a rounded edge which will not cut the legs of the riders. Small holes for screws are punched or drilled in one end of each strap or cleat, and the other ends are soldered to the sides of the cans.

The free ends of the straps are then bent around under the board and fastened with two screws apiece, one in the bottom of the plank and one in the edge.

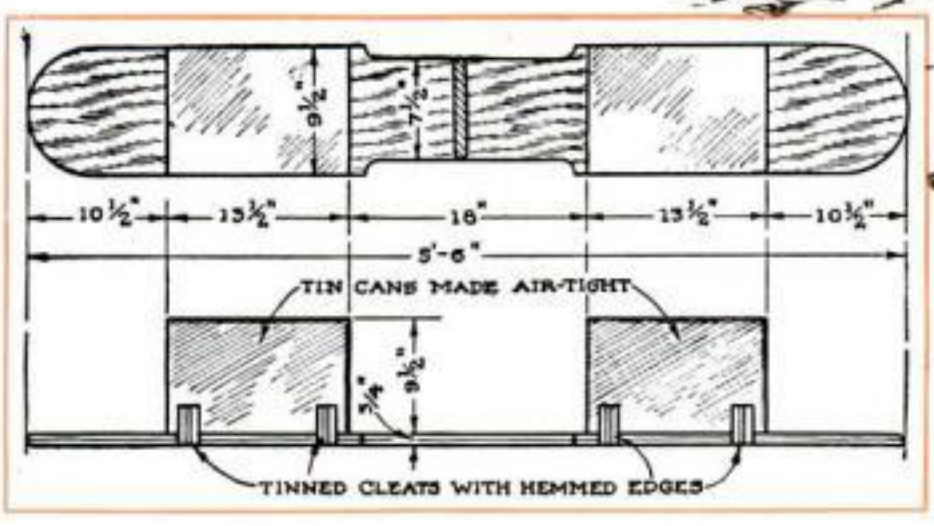
The cans should be fastened on with the handles turned toward the ends for carrying. When painted or enameled in brilliant colors, the pool pony is ready for the water.

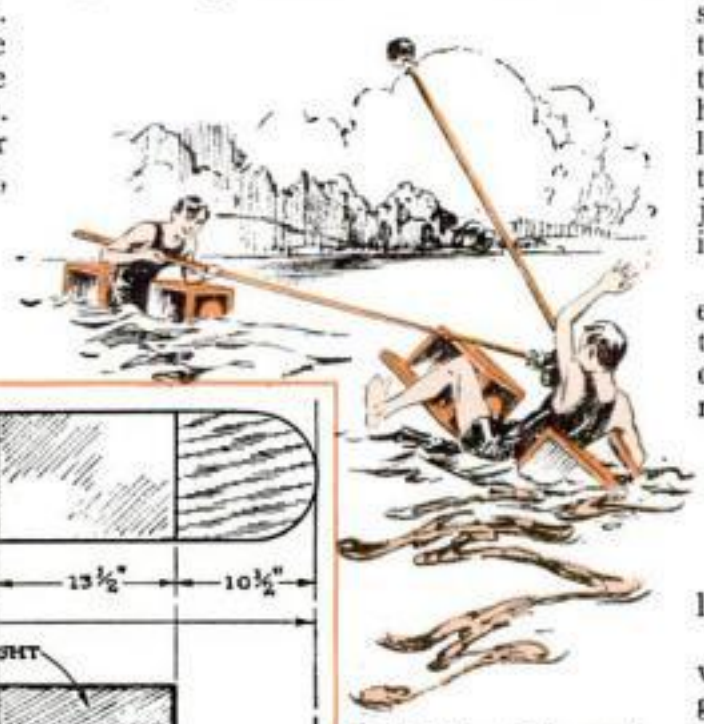
One person may straddle the saddle between the cans and propel himself with his hands, or he may lie with his chest in the saddle and use the pontoons like water wings. Other swimmers may ride bareback on the end seats or perch on top of the cans themselves. When five persons jockey the maritime mare at once, the water line reaches the chins of the first-story riders. The horse is sufficiently steady to be ridden for long distances by those who have learned to control it, but at the least error in judgment it bucks and rolls over, capsizing its cargo of cavalrymen.

A lone water cowboy may mount one end of the plank and cling to the nearest tin can with his legs. This hoists the other end high out of the water and makes riding a feat of skill.

Two persons, one on each end, may use the sea horse as a seesaw, or they may paddle in opposite directions, each one attempting to drive the mount over a previously fixed goal line at his back.

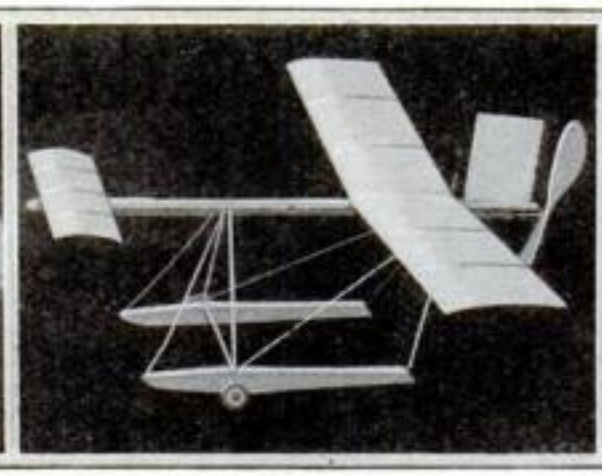
A number of swimmers, if provided with these water steeds, may organize a game of horse and rider. In this tournament each knight of the waves strives to unhorse the others, the last one in the saddle being dubbed "Paddling Paul Revere" until he is vanquished by a greater horseman.



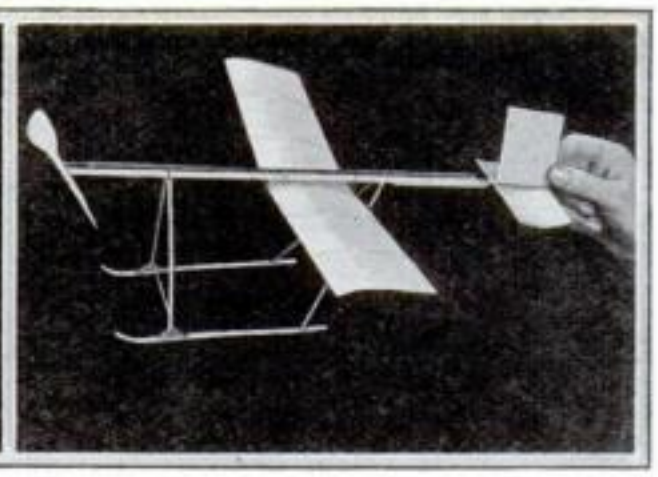


Knights of the sea in watery combat; and *at left*, top and side views of a sea horse which will hold five small riders at once.

The model assembled as a single-stick tractor amphibian. Wing is under the motor stick.



Assembled as an amphibian pusher. In a pusher the wing is on top of motor stick.



By attaching the ski landing gear, the plane can be converted into a rise-off-snow model.

From Ten Parts You Can Build

Twenty Model Planes

By EDWIN T. HAMILTON

THIS single-stick airplane model of ten simple parts is so designed that it can be converted into twenty different types of flying models. It opens new fields for the model enthusiast to conquer. Through building it, the beginner can master a variety of construction methods while actually expending the time and material necessary to make only one model; and the expert can adapt the principles for use on any pet model of his own. To the best of the writer's knowledge, the model is the first of its type.

During the designing, building, and testing of the model, several more complicated methods of construction were developed which might have been improvements, but simplicity was given the preference at all times. Experienced model makers should look upon this design—or, indeed, any design—mainly as a basis on which to build and experiment, but beginners should follow the plans closely so as to be certain of satisfactory flying results.

After you have constructed and flown the model, carry it to the next meet. It will enable you to enter a variety of contests and give you a much better chance of winning a prize.

In this article the ten single-stick arrangements will be described, while the ten fuselage variations will be explained in a following article.

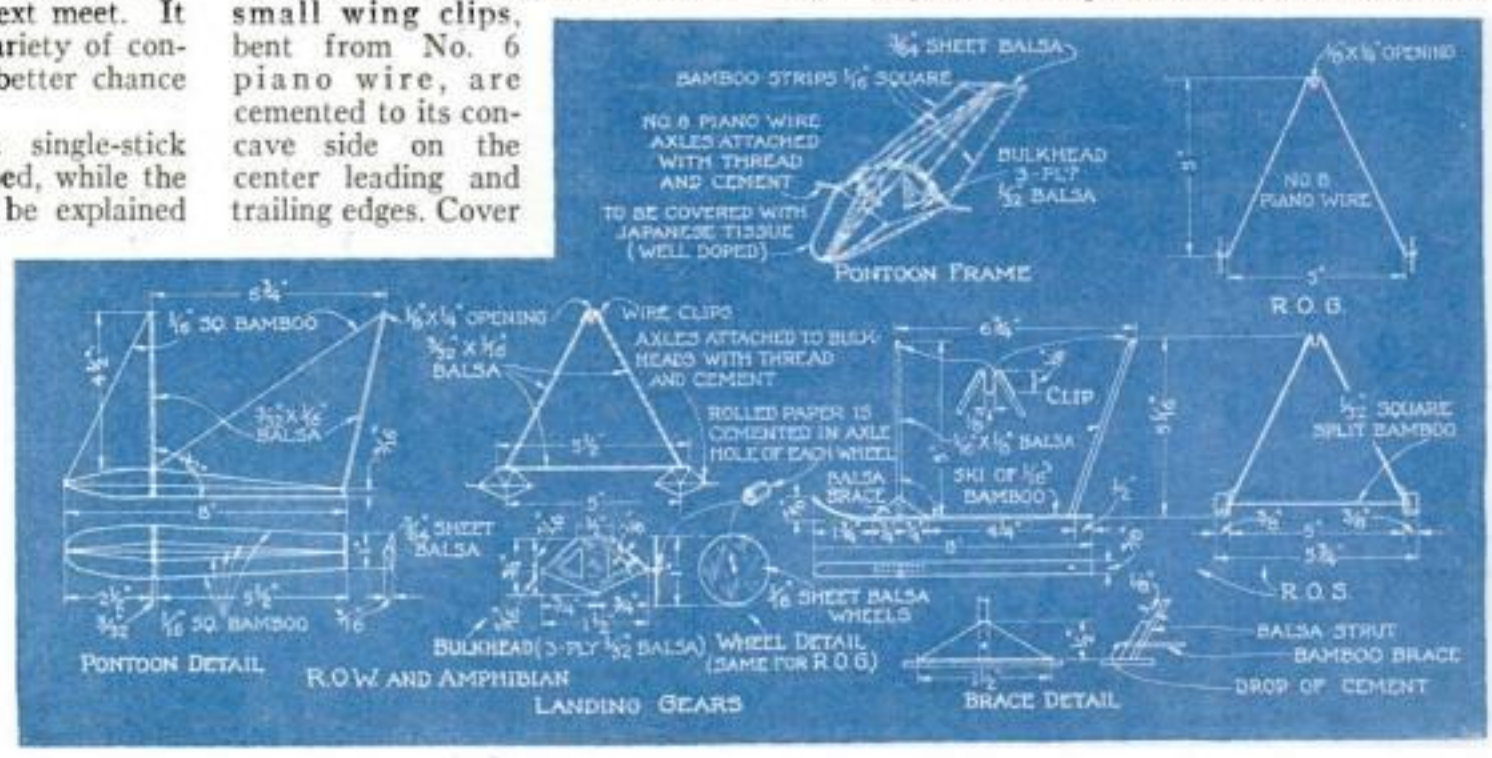
To insure your success in building this remarkable combination of models, two sheets of blueprints (Nos. 135 and 136) have been prepared with full size drawings of all the parts. These can be obtained for fifty cents from the Blueprint Service Department (see page 91).

Motor Stick. Prepare a 1/8 by 1/4 by 15 in. balsa stick. Bend the usual rear hooks and can hooks from No. 6 (.016 in.) piano wire and cement in place, and attach a propeller bearing. In the opposite end of the stick, cut a 1/16 by 1/8 in. slot, 5/8 in. deep; this holds the rudderpost when the model is assembled as a tractor. Two No. 6 piano wire clips also are attached as shown at the front end of the stick and on the edge opposite the propeller bearing.

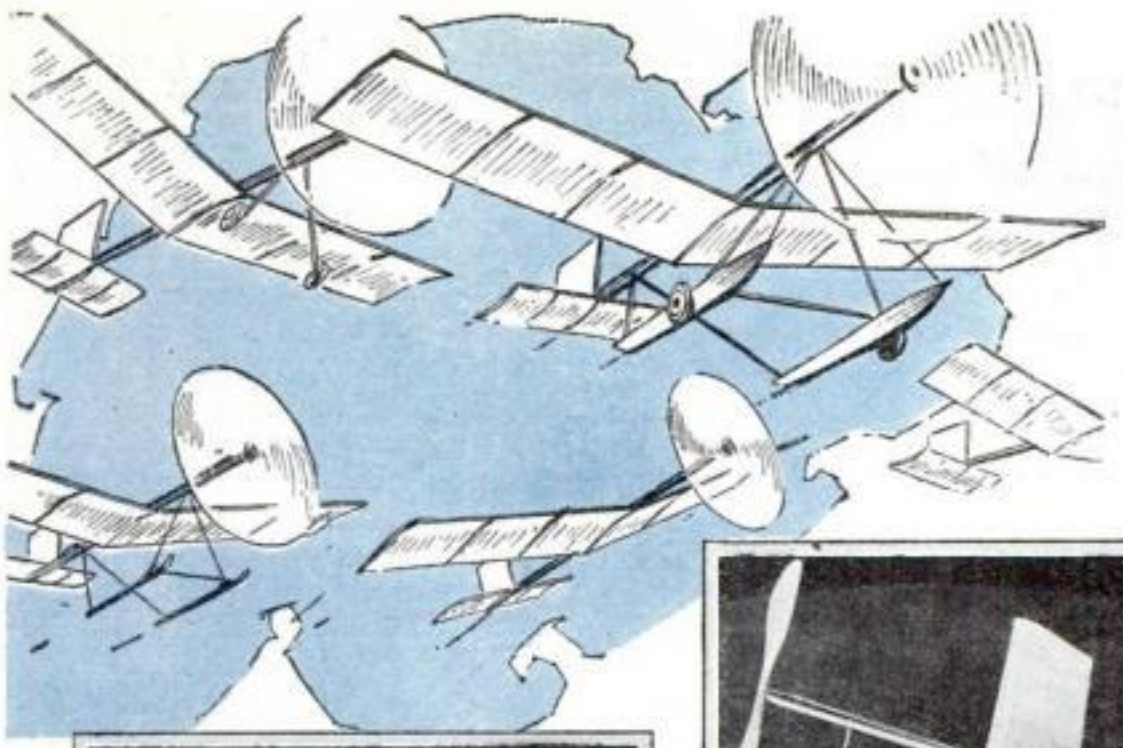
Rudder. Constructed of 1/16 in. square balsa. Its bottom edge, or rudderpost, is a 1/16 by 1/8 in. balsa strip, which begins to taper 5/8 in. from one end until it is only 1/16 in. square at its trailing end. Cover with Japanese tissue on one side only.

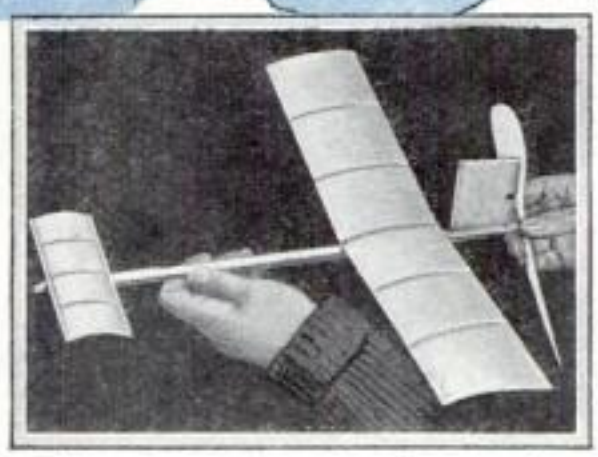
Elevator. Leading and trailing edges of 1/16 by 3/32 in. balsa; ribs 1/32 by 1/16 in., with a 1/8 in. camber. Two small wing clips, bent from No. 6 piano wire, are cemented to its concave side on the center leading and trailing edges. Cover with Japanese tissue on convex side only.

Wing. Leading and trailing edges of 1/16 by 1/8 in. balsa. Five 1/32 by 1/16 in. ribs with a 5/32 in. camber. Large wing clips of No. 6 piano wire are cemented as

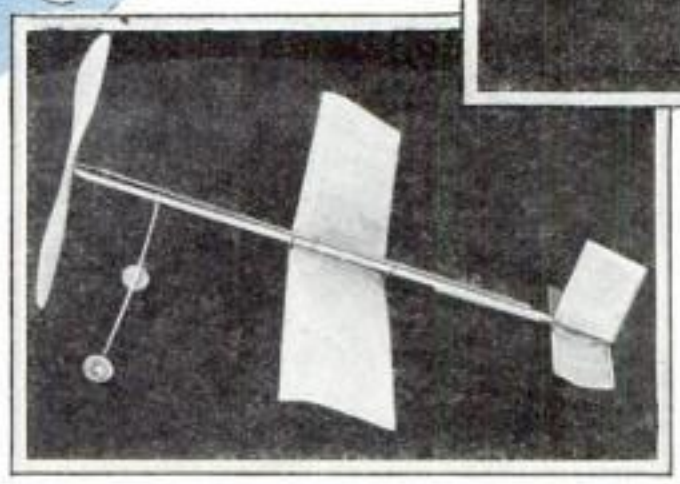


Drawings showing the construction of the landing gear for the rise-off-water, amphibian, rise-off-snow, and rise-off-ground variations of this novel twenty-in-one model. With a plane such as this you can enter all contests.

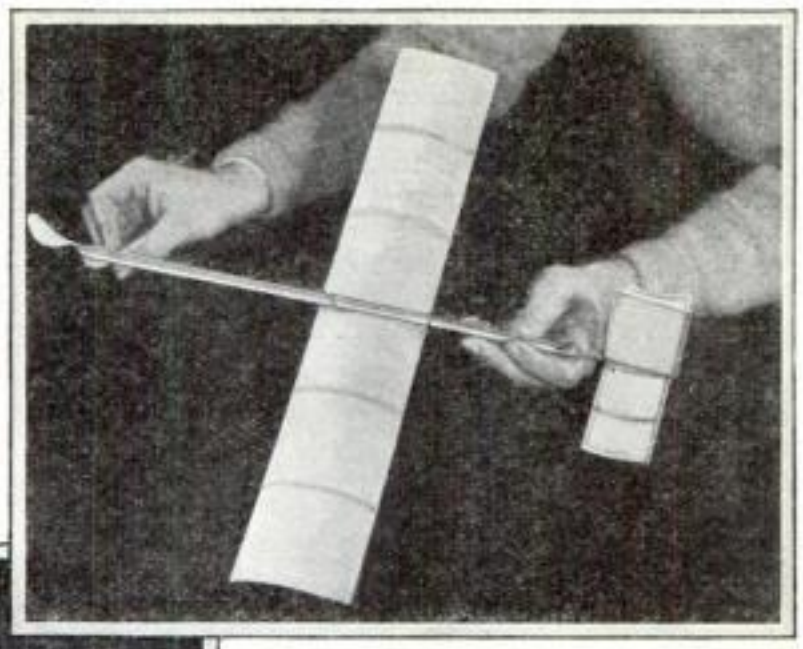




Without landing gear, the plane can be used as a hand-launched pusher or tractor.



By supplying a landing gear, the hand-launched plane is made into a neat rise-off-ground model.



The same "prop" can be used for pusher and tractor by reversing the winding.

Two 1/16 by 3/32 in. balsa uprights are cemented to each pontoon and are joined with No. 6 piano wire clips. Split bamboo braces are cemented in place as shown.

Amphibian Landing Gear. Cement two axles to the outer edges of the two pontoons as illustrated. These are shaped from No. 8 piano wire. Wheels are the same as those used for the R.O.G. landing gear.

To assemble the hand-launched tractor, attach the elevator to the rudderpost by the elevator clips. Insert the rudderpost into the motor-stick slot. Attach propeller with washers. Use one loop of 1/16-in. square Para rubber 30 in. long as the motor. Tie the ends together, pass the rubber through the can hook, and fasten it to the propeller shaft and the rear hook. Attach the wing to the underside of the motor stick, using the clips on the convex side of wing. First test for a long smooth glide, then wind the motor from 200 to 400 turns and launch the model.

By adding the appropriate landing gear, you can convert this model into an R.O.G., R.O.W., amphibian, or R.O.S.

To assemble the hand-launched pusher, attach the elevator to the clip brace on the motor stick. Fasten the rudder to the motor stick by the two front motor-stick clips. The rudderpost projection slips through the loop clip, while the rear of the post is held in the jaws of the regulation clip on the stick. The wing is attached to the motor stick by the two clips on its concave side. When the model is a pusher, the wing rests on top of the stick; when a tractor, on the bottom. Attach pusher propeller, or wind tractor propeller in opposite direction.

This pusher is converted into an R.O.G.

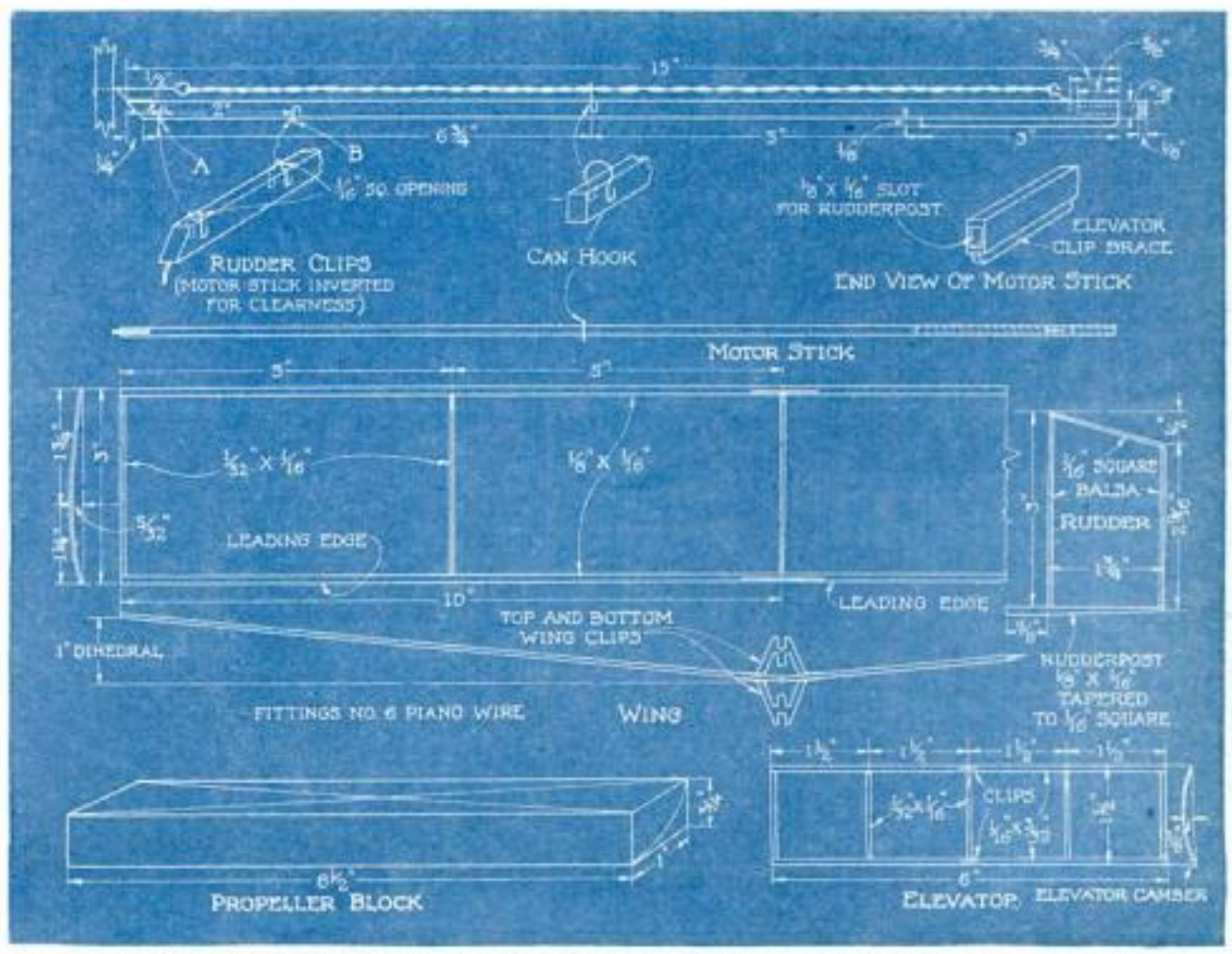
shown to both concave and convex sides of the wing. Cover wing on convex side only with Japanese tissue. Give one coat of diluted dope.

Propeller. Cut in standard fashion from a 3/4 by 1 by 8 1/2 in. balsa propeller block. A tractor and pusher propeller may be made, or the tractor propeller may be wound in the opposite direction when used as a pusher propeller. The propeller shaft is shaped from No. 6 piano wire and cemented through the hub.

Rise-off-Ground Landing Gear. Shaped from No. 8 piano wire (.0197 in.). Wheels are of 1/16 in. sheet balsa. Rolled paper is cemented in the axle hole of each to allow the wheels to turn freely. Clip opening at top should be 1/8 by 1/4 in. Two of these landing gears are necessary.

Rise-off-Snow Landing Gear. The skis are of 1/16 by 3/8 by 8 in. bamboo, curved at their front ends. Two 1/16 by 1/8 in. balsa upright braces are cemented to each ski and are held together at the top with No. 6 piano wire clips, as indicated. A 1/32-in. split bamboo cross brace is cemented through the front uprights and the small triangular braces. The front uprights, braces, and bamboo cross brace are cemented together to the skis.

Rise-off-Water Landing Gear. Cut two triangular balsa ends from 3/64-in. sheeting and six balsa bulkhead pieces from 1/32-in. sheeting. One bulkhead is made by cementing three of the latter together. Complete both at this time. The pontoon stringers are of 1/16 in. square split bamboo cemented to the triangular balsa end piece and the three-ply balsa bulkhead. Cover the structure with Japanese tissue and dope it well.



The skeleton of this model, consisting of a motor stick, wing, elevator, and rudder, is constructed along lines similar to any single stick model. One loop of 1/16 in. square rubber forms the motor.

model by attaching two landing gears, one at the front and the other at the rear of the motor stick. The other three types of landing gear also can be used, giving five types of pusher models in all.

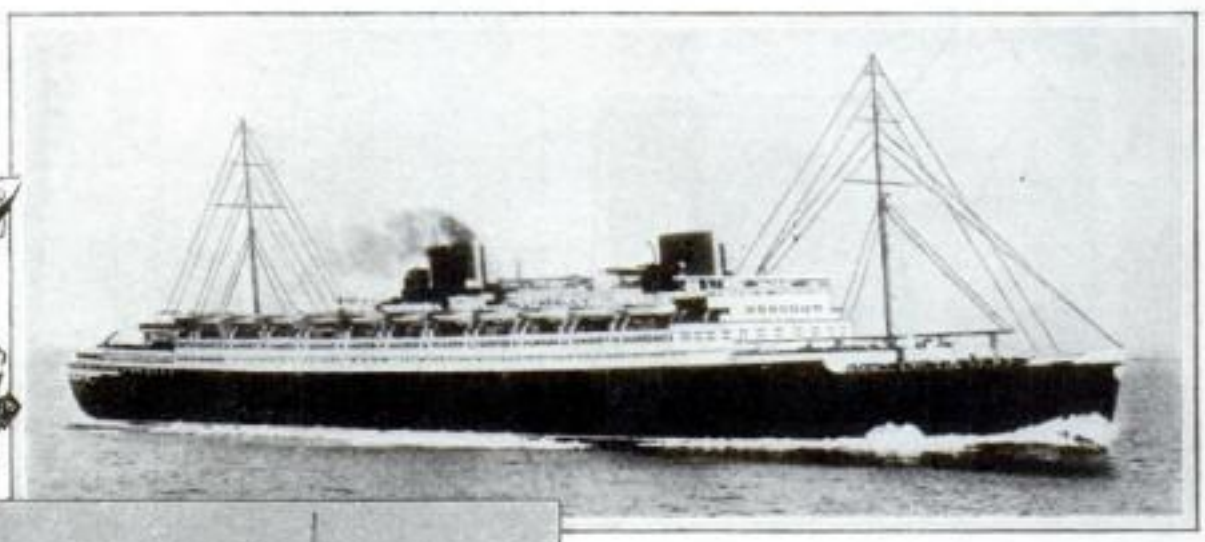
Determine the maximum number of motor turns by winding the rubber until either the stick bends or the strands break. Two strands of high-grade unlubricated Para rubber may take as high as 800 turns. Experiment with three strands as well as two, and try a wider propeller for special endurance tests.

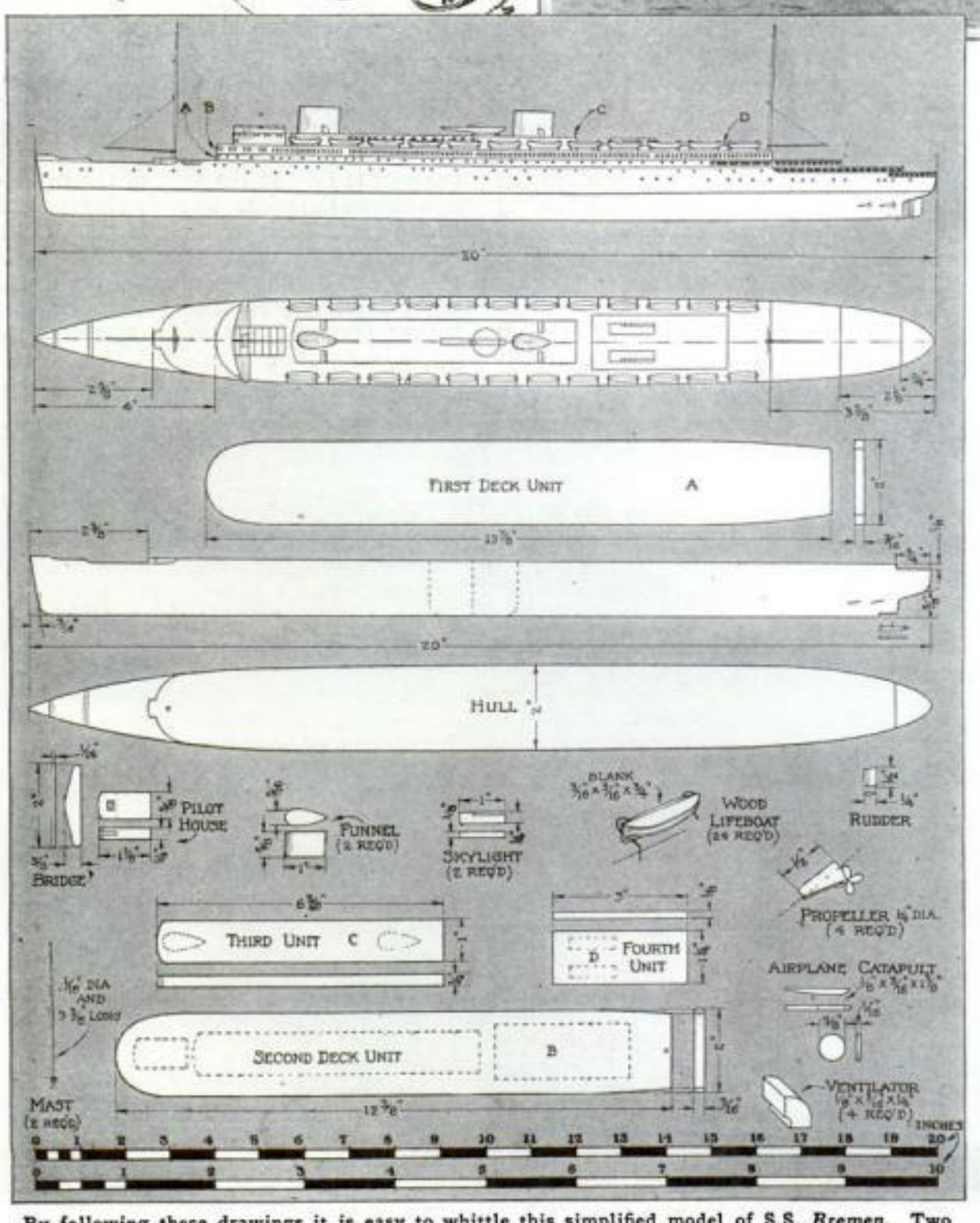
In five outdoor flights under somewhat unfavorable weather conditions because of wind, the hand-launched tractor averaged 2 min. 27 sec. An average of three take-offs gave the following results: R. O. G., 1 min. 19 sec., R. O. W., 1 min. 1 sec.; and R. O. S., 55 sec.

The weights are as follows in drams avoirdupois (16 drams equal 1 ounce): Hand-launched stick model, 4 drams; R. O. G., 5; R. O. W., 7; R. O. S., 7; and amphibian, 7.5.

In a following article Mr. Hamilton will tell how to make a detachable fuselage which can be added to the motor stick to make ten additional models.

A New Fad for Ship Modelers—Carving Tiny Ocean Liners





By following these drawings it is easy to whittle this simplified model of S.S. *Bremen*. Two scales are given: one for a model 20 in. long and the other for a smaller model, 10 in. long.

By DONALD W. CLARK

HERE is a brand-new idea for the model maker who enjoys whittling—a model of one of the world's fastest steamships, the *Bremen*. Little wonder, when you consider their novelty and simplicity of construction, that very small models of ocean-going vessels are fast becoming popular.

In order that you might have a choice as to the scale, two are given in the drawings, one for a model 10 in. long and the other for a model 20 in. long.

With the exception of the four propellers and the propeller hangers, which are made of thin sheet metal, the entire model can be whittled from pine or other soft wood.

First, shape the hull and the four deck units and assemble them, one on top the other, with glue. The streamlined rudder is cut from soft wood and fastened in place with brads. The lifeboats can either be shaped separately and hung from realistic looking wire davits, or shaped as a group in a sort of long molding, which is then glued on each side of the superstructure. With the second method the use of wire is eliminated, and this is desirable if the model is made only 10 in. long.

The funnels, ventilators, and pilot house are glued in place in the positions indicated in the drawings of the deck units.

The hull below the water line is painted red, the boot topping is white, and the topsides black. The superstructure is white, and the two funnels are buff. The windows, doors, and portholes can be painted on in contrasting colors.

The *Bremen* shares with her sister ship *Europa* the title of "queen of the seas." She is an oil-burning turbine ship with four screws and a full-speed rating of 130,000 H. P. (P.S.M., Oct. '29, p. 22).

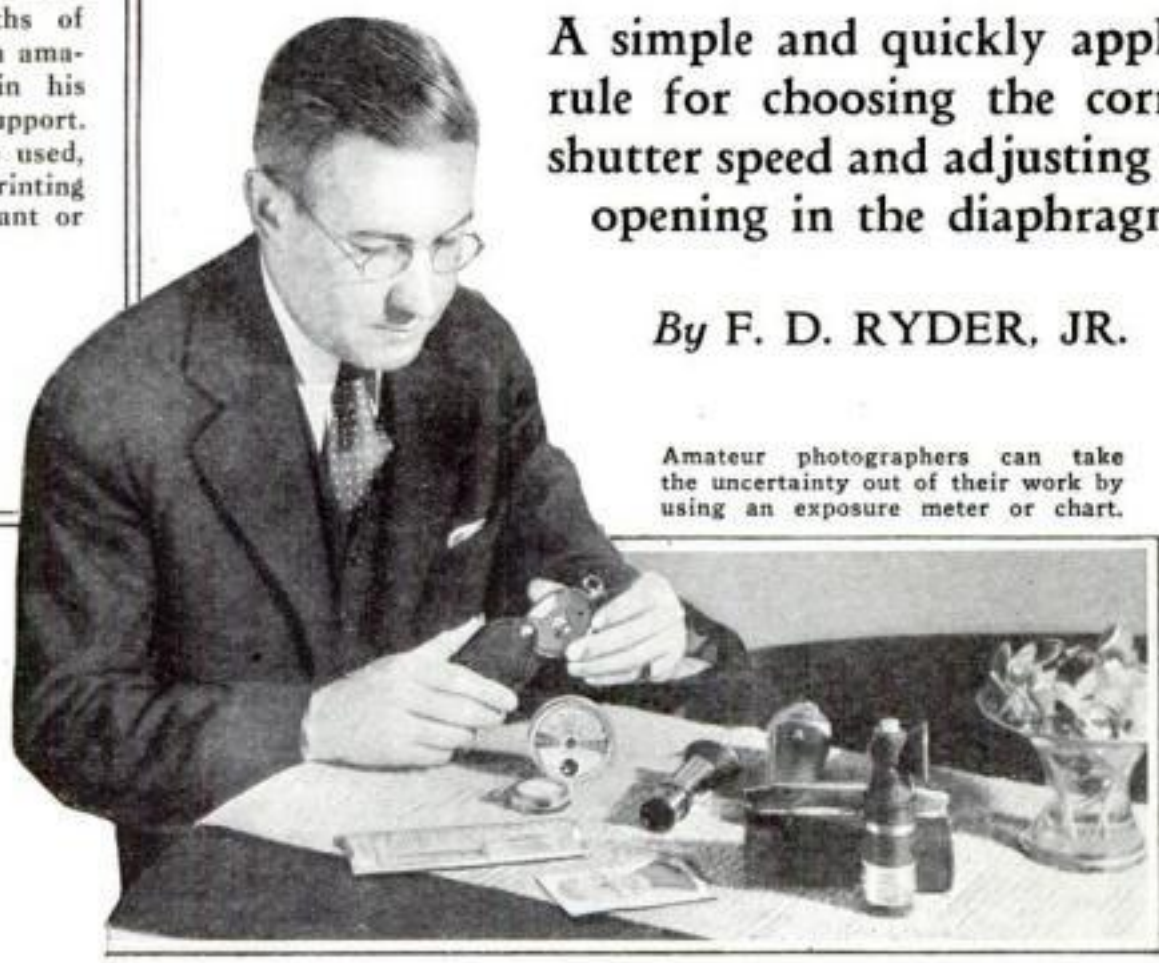
$10 PRIZE
for the Best Photograph

POPULAR SCIENCE MONTHLY will pay $10 for the most photographically perfect snapshot submitted on or before September 1, 1931. It may be of any subject, but must be taken during the months of July and August, 1931, by an amateur holding the camera in his hands without mechanical support. Any type of camera may be used, and the developing and printing may be done by the contestant or by a professional. Mail entries to Photographic Editor not later than September 1. If you wish the photos returned send a self-addressed stamped envelope with your entry.

How to Time Photos Like an Expert

A simple and quickly applied rule for choosing the correct shutter speed and adjusting the opening in the diaphragm

By F. D. RYDER, JR.



Amateur photographers can take the uncertainty out of their work by using an exposure meter or chart.

An exposure meter indicates just how to set the shutter.

WHEN I first started to take photographs, a long while ago, I had a small box camera. The instruction book said to take snapshots only in sunlight between the hours of nine in the morning and three in the afternoon, so I took pictures only on sunny days. However, few of the pictures I took were any good. I blamed my failures on the camera or the film—like many another beginner. Then one day, when I was trying, for the fourteenth time, to take a good picture of my dog, an elderly neighbor stopped to watch me. After I'd snapped nearly a whole roll of film, he made a suggestion.

"Son," he said, "if you'll take that dog round to the sunny side of the house and give him a bone to chew on so he'll stay still, you'll do a lot better."

That was my first lesson in the rudiments of correct photographic exposure. I had figured that so long as the sun was shining it made no difference what I tried to photograph or where I tried to take it. The fine picture I got of the dog proved that sunlight means the sun should be shining on the object you want to take unless otherwise specified.

Later on I acquired a better camera that had a number of adjustments to be made before a picture could be taken. Remembering the advice about the dog picture, I called on my neighbor and asked him what I was to do with all the levers and gadgets on the camera shutter.

"They are all put there," he told me, "so you can regulate the exposure—that is, the amount of light needed to take a good picture; and correct exposure, you'll soon find out, is a mighty important thing in photography. Did you ever hear of the rule, 'doubles or halves'?"

I admitted my ignorance, and he went on to explain a method of calculating photographic exposure that I have since found to be the basis of nearly all mechanical photographic exposure calculators.

He first told me what the levers on the shutter were for and then showed me how they were related to each other. First, there is the speed control that regulates the length of time the shutter remains open. On low priced cameras there are usually only two snapshot speeds, a twenty-fifth of a second and a fiftieth of a second. More expensive cameras can be set for any desired speed from a full second up to about a two hundredth of a second or even a thousandth of a second if the camera has a focal plane shutter. Of course for snapshots, with the camera held in the hand, only a twenty-fifth of a second or faster should be

This illustration was made from portions of three photographs taken one after the other without any change except in the length of exposure. The left end is underexposed, the center is correct, and the right is overexposed.

used. It is impossible, without a tripod, to hold a camera still for an interval longer than that.

The other really important lever changes the size of the opening through the lens that admits light to film or plate. It is called the iris diaphragm because it opens and closes like the iris in the eye. He explained that it made no difference whether you regulate the exposure by changing the speed of the shutter or by changing the size of the opening in the diaphragm. The effect on the plate is the same whether you have a lot of light for a short time or less light for a correspondingly longer time.

"Now," he said, pointing to the speeds marked on the shutter, "notice that each speed is just twice as fast or half as fast as the next in the row, depending on which way you read. That means that when you move the speed lever one division you either double the exposure or cut it in half. The diaphragm lever is marked on the double or half system no matter whether the numbers are U. S. 4, 8, 16, 32 and so on or F/4.5, F/5.6, F/8, F/11 according to another method. In either case moving the diaphragm from one number to the next either doubles the exposure or cuts it in half."

He showed me how the classification of the different intensities of light and of subject also are arranged on this same double or half system. The light, for example, may be bright sun, hazy sun, cloudy bright, or cloudy dull. A change in light from one division to the next would call for doubling or halving the exposure. Your subjects may be distant views, medium views, or close-ups. Here, too, a change from one to the other would necessitate doubling or halving the exposure.

As my photographic neighbor pointed out, the best way of estimating exposure is, therefore, to keep your shutter set for average conditions and then make changes by doubling or halving the exposure to correct for stronger or weaker light or for nearer or more distant subjects.

You will find that an average subject from twenty-five to fifty feet away lighted by direct sunlight on an ordinarily sunny day can be successfully photographed with the shutter speed set at a twenty-fifth and the diaphragm set at U.S. 8 or F/11. For very bright sunlight, change the shutter to a fiftieth of a second or the diaphragm to U.S. 16 or F/16 (the two systems cross at this point). Consider the light and subject independently and make the proper correction for each.

I strongly recommend the use of an exposure calculator or meter. Many kinds can be obtained at various prices. Some are better than others, but all are good. They save you mental gymnastics, for even doubling or halving can become complicated.

The illustration at the bottom of page 75 shows what happens when you overexpose or underexpose a photograph. The illustration was made from prints taken without moving the camera or making any changes except in the length of the exposure. The center section was printed from the correctly exposed negative. The right end, which is muddy and a trifle blurred, is a portion of the overexposed photograph. The dark left end is part of the underexposed view.

Mr. Ryder will be glad to answer photo questions, or criticize prints if accompanied by negatives. Inclose self-addressed, stamped envelope for reply.

Follow These Five Rules to Get Good Pictures

1. **Keep your camera set for a twenty-fifth of a second with lens stopped to U.S. 8 or F/11. This gives correct exposure on average sunny days for objects from twenty-five to fifty feet away in the direct sunlight.**
2. **Cut the exposure by half in very bright sunlight, double it for bright cloudy days, and double again for dull days.**
3. **Cut the exposure by half for distant views or double it for close-ups.**
4. **Make the correction for light difference first; then double or halve the result according to the subject.**
5. **When in doubt, play safe by increasing the exposure.**

Colorful Shellacked Cloth Tops Add Novel Note to Tables

COLORFUL chintz and other decoratively figured fabrics make attractive and serviceable coverings for table tops. They are suitable for kitchen tables, dressers, card tables, children's furniture, and the like.

There are several ways in which you can apply and treat the cloth. One of the easiest is to shellac the table surface and then apply the covering immediately, the goods having been previously cut to shape. Smooth out the cloth and allow an hour or so for drying; then apply a coat of shellac over the fabric, using enough to saturate the covering thoroughly. Let this dry for three hours or more, and give the cloth two or more coats of floor wax.

Liquid glue may be used to fasten the cloth to the table, if preferred; and instead of shellac and wax for the finish, you may substitute clear lacquer, varnish, or wax alone, varying the drying time. Be sure the cementing coat is dry before finishing.—W. E. B.

The table top is given a heavy coat of shellac, which serves as a cement. Then the fabric is spread smoothly on the surface and allowed to dry, after which a finishing coat is applied.

She had to have her birthday cake on her new play table—she liked the gay top so well.

A Circus Wagon Toy Box

Teaches Children to Put Their Things Away

By CHARLES M. RICE

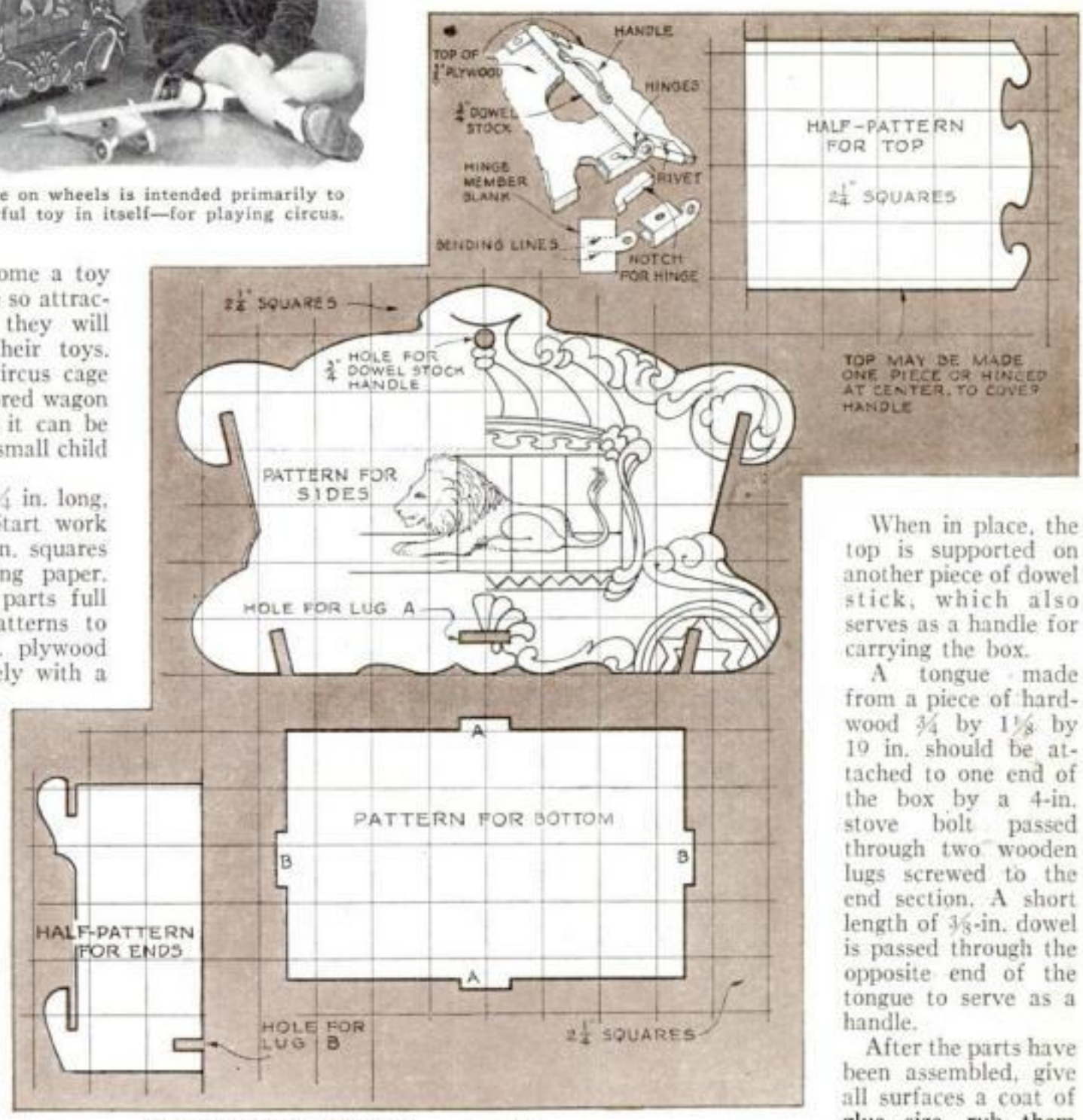
This brilliantly painted lion's cage on wheels is intended primarily to hold other toys, but it's a wonderful toy in itself—for playing circus.

EVERY mother will welcome a toy box fashioned in a shape so attractive to children that they will cheerfully gather up their toys. Such a box is the miniature circus cage illustrated. The brilliantly colored wagon is mounted on casters so that it can be pulled from place to place by a small child even when fully loaded.

The box is 13½ in. wide, 24¾ in. long, and 15¾ in. high over all. Start work by drawing a number of 2¼-in. squares on a sheet of heavy wrapping paper. Carefully lay out the various parts full size; then use these paper patterns to mark the shapes on the ⅜-in. plywood and saw out the parts accurately with a coping saw, power jig saw, or band saw.

Obtain inexpensive casters of the type having a plate drilled for four screws and fasten them to two strips ¾ by 2½ by 10 in. as shown below. Use flathead screws for attaching these strips to the bottom.

The top is made in two parts so that it may be folded when not in use. The hinges are cut from heavy sheet metal, as shown, all four parts being alike. Each part is bent to clasp the corner of the wood, in which a recess is cut as indicated in the drawings. Rivet the hinges to the plywood and pivot them by means of two roundhead screws driven into the ends of a 10-in. length of ¾-in. wooden dowel rod. A metal handle is screwed to the dowel.

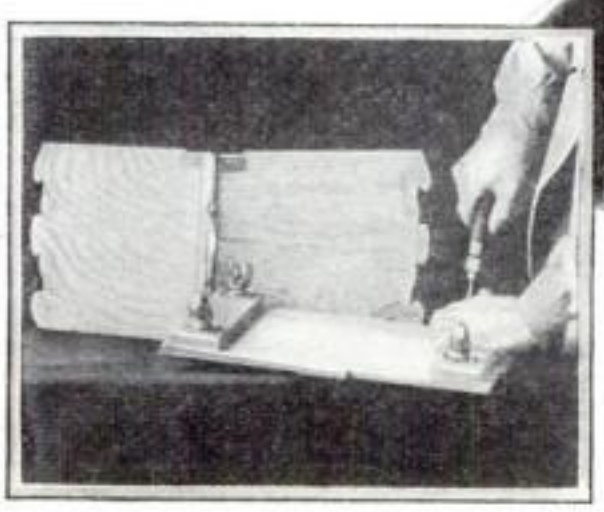


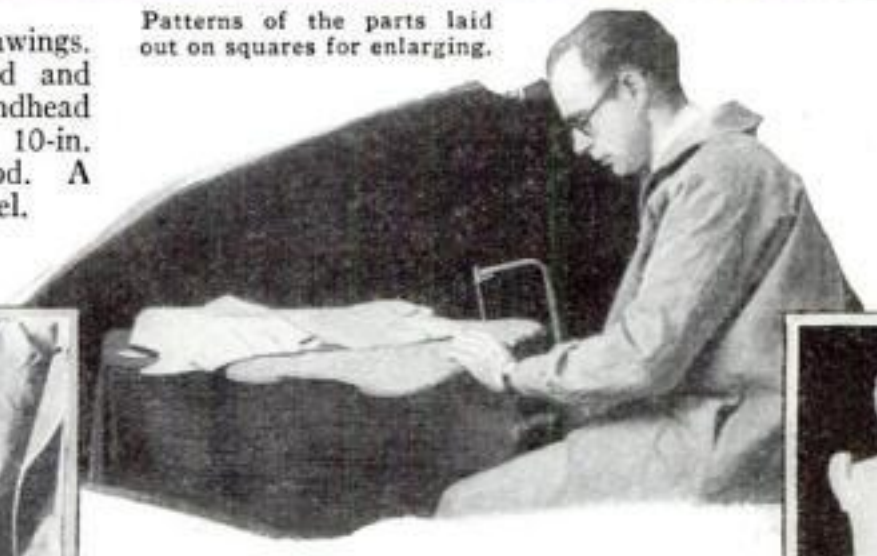
Patterns of the parts laid out on squares for enlarging.

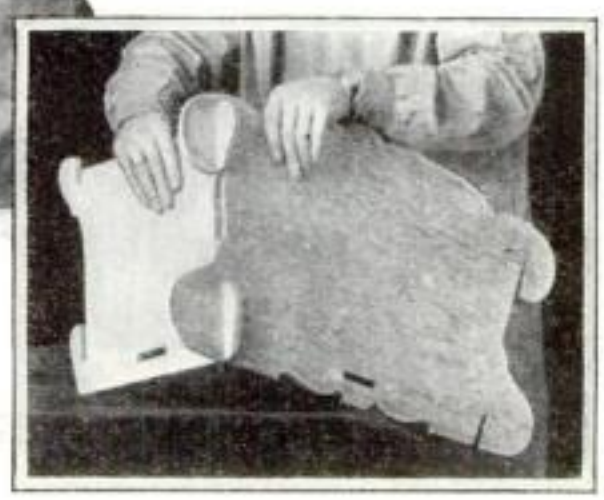
When in place, the top is supported on another piece of dowel stick, which also serves as a handle for carrying the box.

A tongue made from a piece of hardwood ¾ by 1⅛ by 19 in. should be attached to one end of the box by a 4-in. stove bolt passed through two wooden lugs screwed to the end section. A short length of ⅜-in. dowel is passed through the opposite end of the tongue to serve as a handle.

After the parts have been assembled, give all surfaces a coat of glue size, rub them with No. 00 sandpaper, and apply one or more coats of yellow enamel or lacquer. The design may be painted after the outlines have been transferred to the box with ordinary carbon paper.







Above: Sawing out the parts. *At left:* The top and bottom. *At right:* Fitting the joints. Use yellow for the body color. Then paint the lion; color the wagon tongue and chief outlines and edges bright red; add touches of bright green to the wheels; high-light the background with white; and stripe top and ends in red and green.

Left: An exceptional top view of the partially completed hull showing the deck frames, well for centerboard, and transom knee. *Below:* The author sailing his 15-ft. two-purpose boat.

We complete the hull and rigging for our *Combination*

Sailboat-Motorboat

By WILLIAM JACKSON

NO MATTER what preferences you may have regarding a small boat, *Dauntless* will meet your requirements far more completely than any ordinary design. Pleasure jaunts, quick trips to town, fishing, hunting, sailing, motorboating—all these come within the scope of this 15-ft. combination boat built to operate efficiently with either sail or outboard motor.

The construction is not at all complicated, and to make the work even easier for those who have had little boat building experience, three blueprints have been prepared which contain larger drawings than it is possible to include in the magazine. These prints will save you time and effort. (See Nos. 131, 132, and 133 in the list on page 91.)

Last month we completed the frame of our boat (P.S.M., July '31, p. 79). In applying the planking, the side planks are put on first. As in the case of the inwales and chines, both side planks are applied simultaneously. This is done to prevent the frame from being twisted out of shape, which would be the case if one side was planked before the other. Clamp the planks in place, mark them to shape, remove, and cut them to the lines, being careful to keep the saw outside of the line. Next, coat the chines, transom, and stem with glue, clamp the planks in place, and fasten with 1¼ in. No. 8 F.H. screws spaced 2½ in. apart. Countersink these screws slightly.

When both sides are in place, trim the edges flush with the transom, chines, and stem, and bevel the planking from frame No. 1 to No. 4 to receive the bottom planks.

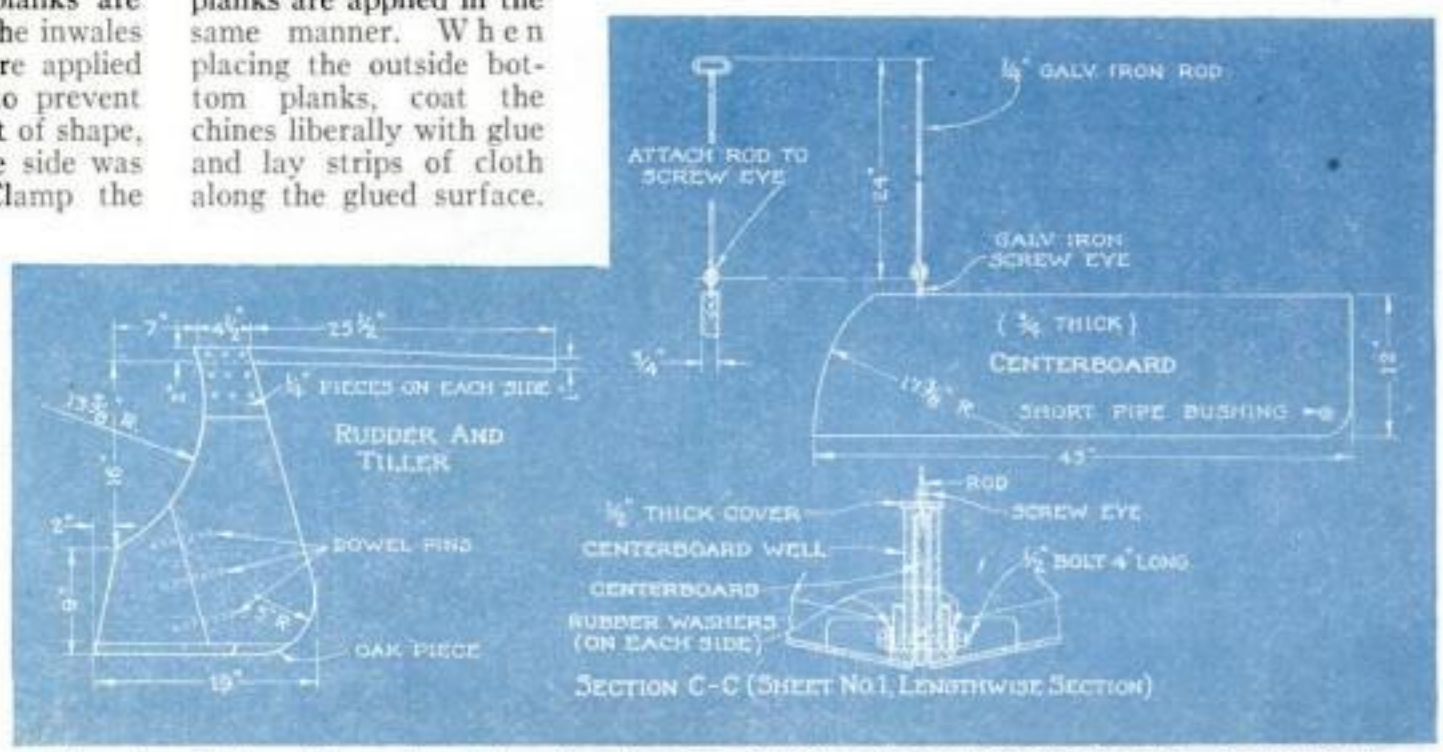
In planking the bottom, work from the keel outward. Place the first two planks so that their inside edges follow a center line drawn on the keel. Where the keel planks overlap at frames Nos. 1, 2, and 3, remove the excess wood with a saw. The slot for the centerboard well also should be sawed at this time.

Before fastening the first two planks in place, lay strips of cloth along the transom and around the centerboard slot and coat the joint edges with glue or white lead. Fasten the planks to the frames, keel, stem, and transom with 1¼-in. No. 8 F.H. screws, slightly countersunk and spaced about 2½ in. apart, and to the intermediate frames with 1¼-in. galvanized nails spaced 2 in. apart. If these center planks are wrapped in burlap soaked with hot water, it will assist greatly in bending them to fit the curve of the bottom frames.

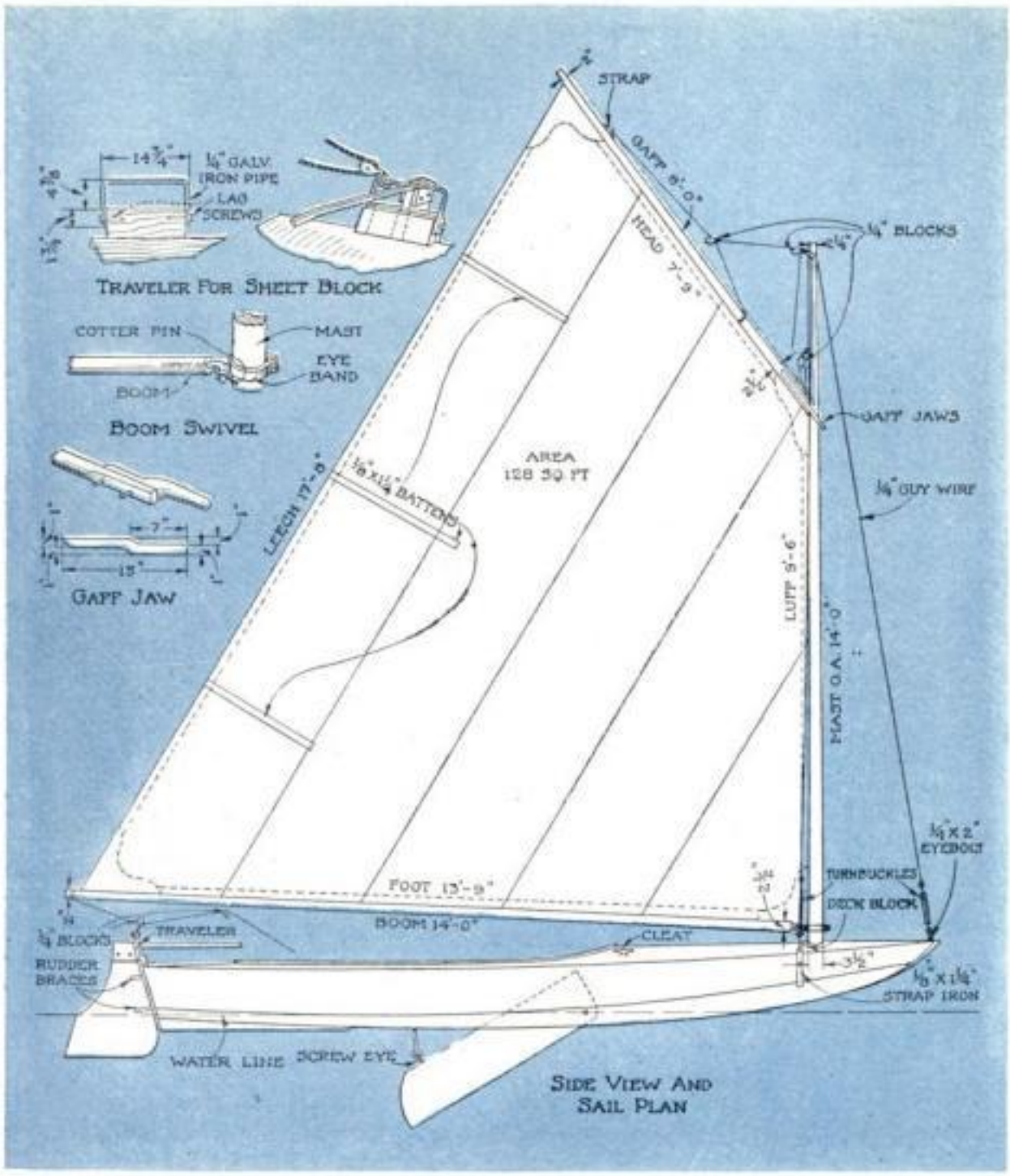
The remaining bottom planks are applied in the same manner. When placing the outside bottom planks, coat the chines liberally with glue and lay strips of cloth along the glued surface. The edges of all the bottom planks should be planed so that they fit tightly together on the inside and are open about 1/16 in. on the outside to allow for calking.

When the sides and bottom are planked, the hull can be removed from the form, and the edges of the planking along the inwales planed flush. Clamp the deck beams to their respective frames and fasten each in place with one ¼ by 1¾ in. carriage bolt. The cockpit beams are fastened to the frames with two 1¼-in. No. 8 F.H. screws. Fasten each support to the cockpit beams and frames with two 1¼-in. No. 8 F.H. screws. The mast step is fastened in place with three 2¼-in. No. 9 F.H. screws at each frame.

The center deck plank, which is called the "king plank," is fastened to each deck beam with three 2-in. No. 9 screws. Cut a



Drawings of the rudder and centerboard, and section detailing the centerboard assembly. Larger drawings of this 15-ft. boat can be obtained by sending seventy-five cents for Blueprints Nos. 131, 132, and 133.



Sail and rigging plan and details showing the sheet-block traveler assembly, boom swivel, and gaff jaw. Yacht twill is used for the sail and 4 by 4's serve as stock for the spars.

hole 3½ in. in diameter in the "king plank" directly over the hole in the mast step.

The forward centerboard post, which is coated with glue or white lead and pushed up through the centerboard slot until its bottom edge is flush with the bottom of the keel and its top edge projects 1½ in. above the deck beam, is fastened to the deck beam with two 2-in. No. 9 F.H. screws. Fasten the bottom ends of the centerboard posts to the keel with one 2¼-in. galvanized nail. Coat the posts with glue or white lead and drill a hole for the nail before fastening it in place.

In order to place the two well boards, remove the keel blocks from frames Nos. 5 and 6 and saw the frames to allow the well boards to fit flush against the keel on each side of the centerboard slot. Coat all joints liberally with glue or white lead and lay strips of cloth along all edges. Clamp the side boards to the well posts and fasten with 1¼-in. No. 8 F.H. screws spaced 2 in. apart. Drive 2¼-in. No. 9 screws up through the keel into the bottom edges of the well boards and nail ¾ by 3 in. blocks along the sides between each frame. Over these blocks nail a ¾ by 1 in. strip the full length of the well boards.

Fasten the ½ by 2 in. inside coaming to each cockpit beam with two 1¼-in. No. 8 F.H. screws. The oak transom knee and breastplate are fastened in place with 2-in. No. 9 F.H. screws.

The hull is then planed and sanded smooth, and a priming coat of paint is applied inside and out. Work the paint well into the seams. While it is still wet, push cotton calking into the cracks between the planks with a putty knife. When the paint is dry, work over the seams with a composition putty or seam filler. The use of a composition putty or filler is advised as it will last longer than ordinary putty. After the putty dries apply two more coats of paint, inside and out.

The remainder of the decking is fastened to the deck and cockpit beams with 1¼-in. No. 8 F.H. screws spaced about 2½ in. apart. If a natural finish on the deck is desired, leave a 1/16-in. seam between adjacent planks for putty. For general use, the deck should be covered with canvas.

With the deck in place, fit the ⅜ by 4 in. outer cockpit coaming against the centerboard post at frame No. 4 and fasten it with 1-in. No. 6 F.H. screws spaced 4 in. apart. The outer coaming should project about 1 in. above the deck. Fasten a ⅜ by 1⅛ in. molding to the sheer of the hull with screws spaced 6 in. apart. Bolt the motor boards to the transom with eight ¼ by 1¾ in. carriage bolts.

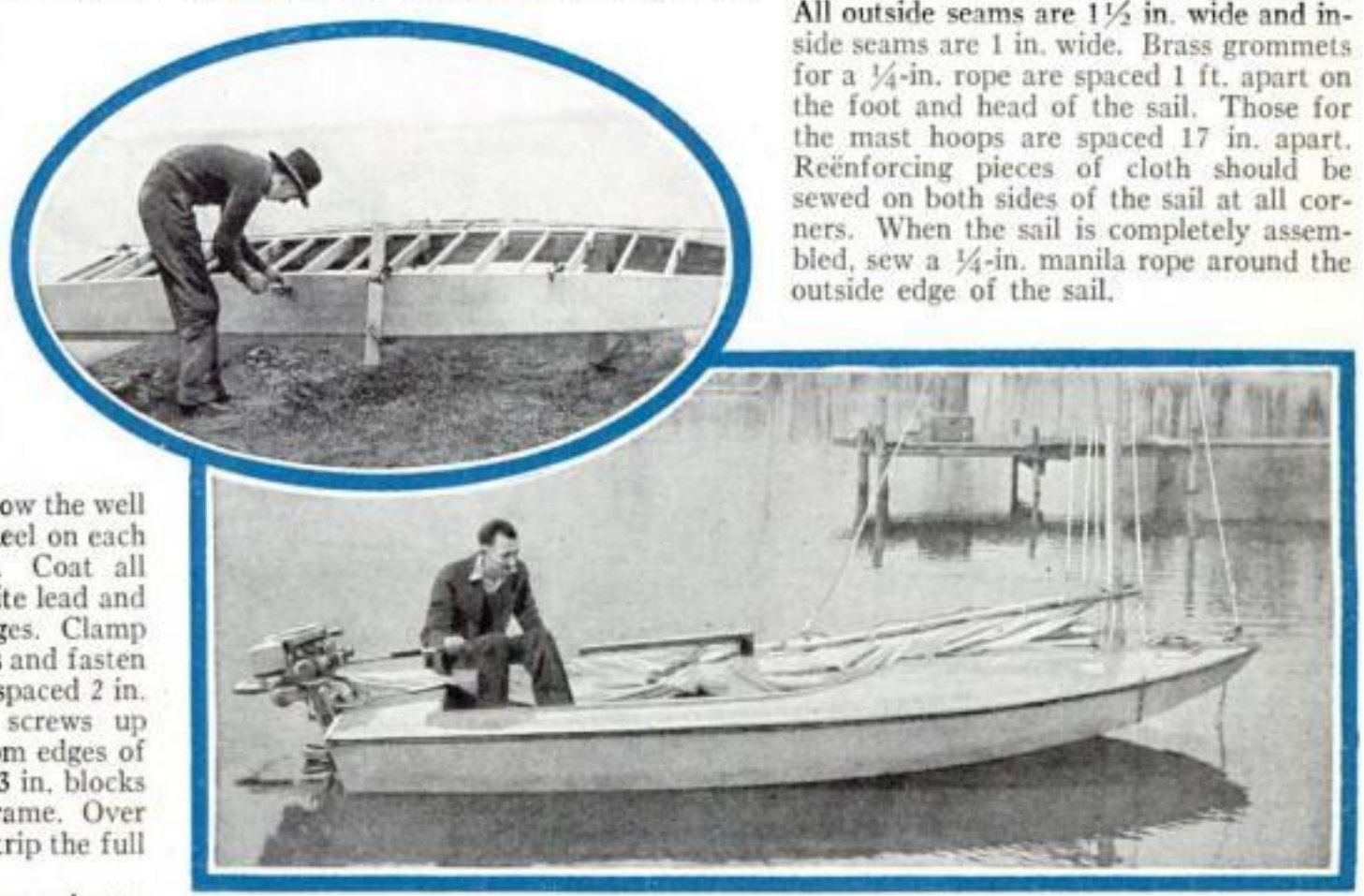
The rudder, which is made in two pieces, is fastened together with dowels and glue. The oak piece at the bottom of the rudder is fastened with four 2¼-in. No. 9 F.H. screws. Two ¼ in. thick pieces are used to hold the tiller in place. These are fastened with eight 1-in. No. 6 screws in each.

The centerboard is hinged at its forward end on a ½ by 4 in. carriage bolt. Use rubber and metal washers on each side of the well boards to keep out the water.

The after keel is fastened in place with six 2¼-in. No. 9 F.H. screws driven through from the inside.

Boom, gaff, and mast can be made from 4 by 4's. Finish spars by sanding, and apply three coats of spar varnish. The bottom end of the mast should be cut square for 2 in. to fit in the mast step.

Yacht sail twill (6-oz.) is used in making the sails. If this is not obtainable, a good grade of muslin will serve the purpose. The lengths of cloth can be sewed together on an ordinary sewing machine. All outside seams are 1½ in. wide and inside seams are 1 in. wide. Brass grommets for a ¼-in. rope are spaced 1 ft. apart on the foot and head of the sail. Those for the mast hoops are spaced 17 in. apart. Reënforcing pieces of cloth should be sewed on both sides of the sail at all corners. When the sail is completely assembled, sew a ¼-in. manila rope around the outside edge of the sail.

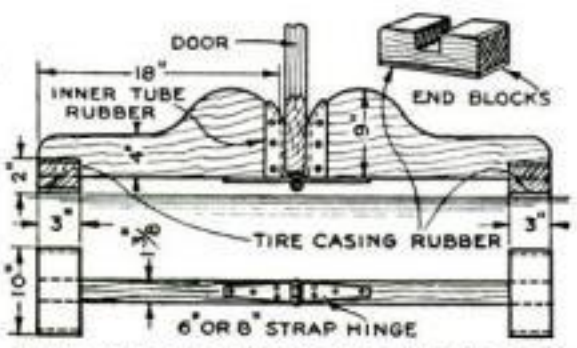


By lowering the sail and attaching the outboard motor, the combination boat is transformed into a motorboat. *Insert:* The side planks are applied simultaneously so as not to twist the frame.

SURE-GRIP CLAMP HOLDS DOORS FOR PLANING

HOME owners often have to plane the edges of a door or sash that binds or make other repairs to them, and it is usually a problem to find a suitable way to hold them while the work is being done. Carpenters have many makeshifts for this purpose, but a nonslipping clamp made as shown is much better because it holds work of various thicknesses with a powerful grip. It requires no adjustment, does not injure the finish, and has the further advantage of folding up.

The clamp preferably should be made of oak, ash, or elm. Yellow pine will answer but is more likely to split. The working ends of the two jaws and the exposed central part of the strap hinge are covered with a strip of inner tubing tacked in place; and pieces of tire casing are nailed on the blocks at the bottom of the outer ends of the jaws to keep the clamp from slipping. The harder a door is pressed into the clamp, the tighter the grip.—B. P. SEWARD.



Front and bottom views and sketch of one of the end blocks of the self-adjusting clamp.

REMOVING OLD LACQUER FROM METAL WARE

WHEN the lacquer on silver, brass, and copper articles becomes checked and chips off, as often happens, the pieces quickly show discoloration in places and require to be repolished. Before this can be done, however, it is necessary to remove the lacquer. An easy way to do this is to soften it with a solution of equal parts of "banana oil"—a bronzing liquid—and denatured alcohol and wipe the metal clean with a soft cloth.—D. H.

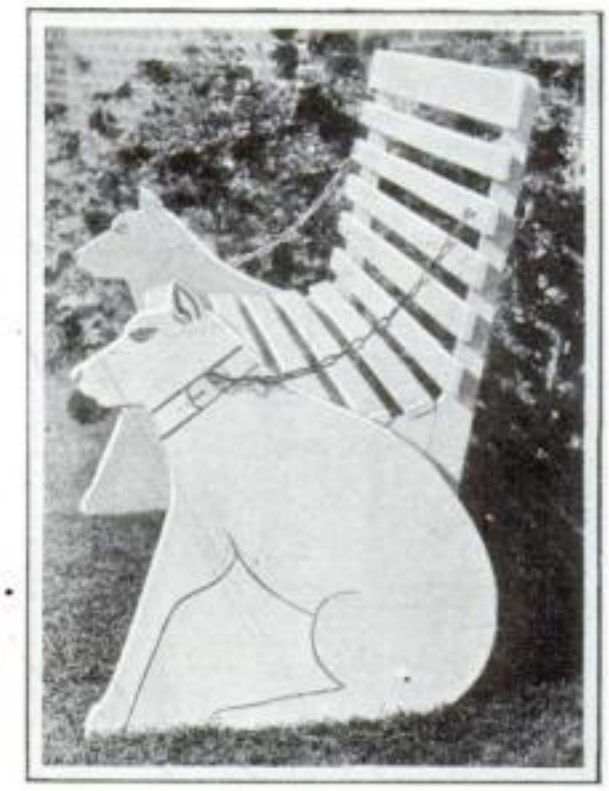
NOVEL GARDEN SEAT PLEASES CHILDREN

DESIGNED especially to please children, this unusual seat with dog-shaped ends makes an attractive addition to any garden nook.

Each of the dogs is 24 in. high to the tip of the ear and 22 in. wide over all. They are sawed from a wide board of 1 in. thick pine, cypress, or other durable wood. If a board of sufficient width cannot be obtained, narrow pieces may be doweled and glued together with casein (waterproof) glue. The grain of the wood should run the long way of the dog's body so that the ears and nose, which are the weakest parts, will not be so easily knocked off. Cleats 1 in. square are screwed on the inside at the bottom as a reënforcement, and the wider and slightly curved cleats which support the seat strips also give additional strength.

The seat is 40 in. long from dog to dog and about 16 in. off the ground. The uprights which support the back are 1¼ by 2 by 35 in., tapering to a width of 1¼ in. at the top. Oak or other hardwood is used for these and also for the strips, of which the following are required: one piece ½ by 3 by 40 in. for the top of the back, five ½ by 1¾ by 40 in. for the remainder of the back, and five similar strips for the seat. A rounded molding is fastened to the front of the seat.

All the parts are screwed strongly together, and two braces which cross in X-fashion with a half lap joint at the center are screwed to the front edges of the rear uprights underneath the seat.



The dog-shaped ends of this bench fascinate children and even induce them to sit still.

Give the wood a coat of boiled linseed oil and allow it to dry thoroughly; then apply two coats of outside white paint. Use black paint to give the finishing touches to the dogs, and add the two chains, which run from screw eyes in the "collars" to other screw eyes in the back, as illustrated.—ROSE AUSTIN.

NEW GAME TESTS SKILL IN FLIPPING AN EGG

THE object of this novel new game is to flip the "egg" upside down and catch it as nearly as possible in the center of the "frying pan." Any player who succeeds in catching it within the inner circle wins first place; the other players are credited with the number of the outer or largest circle within which the "egg" falls. If its edge just touches one of the black dividing lines, the throw counts for the number outside the line—the higher number. Missing the "pan" altogether counts 20. The "egg" should be placed in the center of the pan before each attempt.

After five times around, the scores are added up and the players rated according to the lowness of their individual totals.

The "pan," which is 6 in. in diameter, is sawed from a piece of 3/16-in. or thicker wood, painted as indicated. The "egg" is made of either thin wood or heavy cardboard. It is painted white on both sides; then a yellow spot is added on one side—the side which is placed uppermost before the "egg" is flipped.—D. W. C.

"Frying pan" with numbered rings and the "egg" in place ready to toss up.

Data used in drafting can be placed on the T-square and covered with a celluloid strip.

DRAFTING FACTS KEPT HANDY ON T-SQUARE

ANYONE who uses the drawing board frequently, especially for machine designing, will find it convenient to fasten all the necessary data sheets to the T-square and cover them with a strip of clear celluloid. Decimal equivalents, screw threads, sheet metal and wire gages, drill and tap sizes, and other information may be kept available in this way.—H. LEUTNER.

Sharpening Your Circular Saws

By CHARLES A. KING

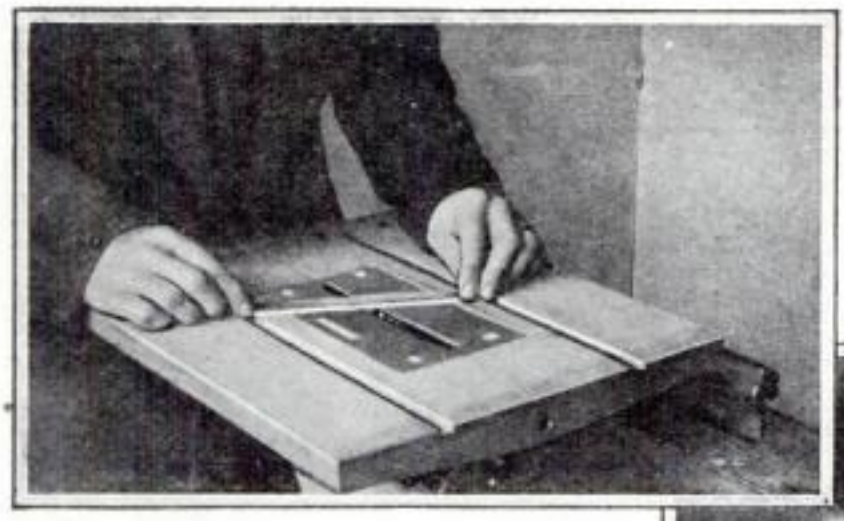
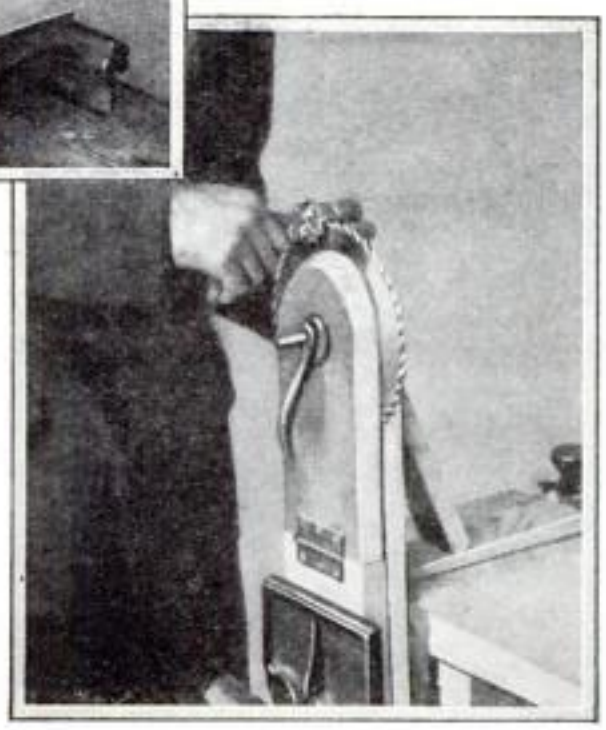


Fig. 1 *(right).* In jointing a circular saw with a file, oilstone, or emery block, adjust the height slowly as it is dangerous to try and cut down the teeth too much at a time.

Fig. 2 *(below).* The saw is held in the clamp for setting.



FOR sharpening small circular saws, the only equipment needed is a circular saw filing vise, a hand saw set, an 8-in. double-cut smooth flat file, an 8-in. round file, and 8-, 10-, and 12-in. regular taper saw files, all with handles. The saw files are of the heaviest triangular type used for handsaws, and they have single-cut, smooth teeth.

The vise can be made as shown in Fig. 3. It was designed so that the top is 3 ft. 9 in. from the floor to suit the writer, but the dimensions may be modified.

The back jaw is cut from a piece of any easily worked wood ¾ by 5 by 17 in., the front jaw from a similar piece 11 in. long, and the hinge block from a piece 1 by 6 by 5 in. (the grain running the 5-in. way). Draw the half circle on the face jaw, hold the jaws together temporarily with 1½-in. brads, and saw both at once. Bore the ½-in holes at *A*, separate the jaws, chamfer ooth as indicated, trim the slot between the holes *A* so that a ½ by 3 in. bolt (with wing nut and two washers) will move easily but not loosely the entire length, and fasten the hinge block to the inside of the back jaw with 1½-in. No. 10 screws. Assemble with a 3-in. hinge. Since a vise of this type usually will spring slightly under the filing pressure, it is well to add the hinged brace *B*, held by a wedge *C*.

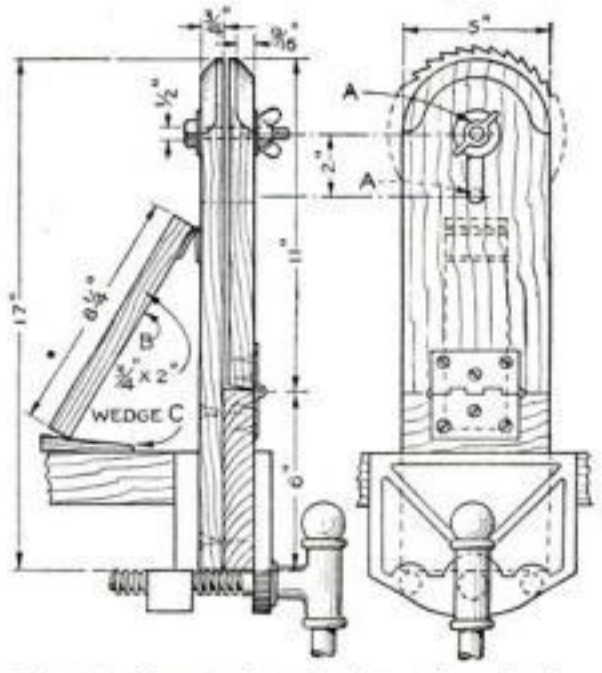


Fig. 3. Front and end views of a circular saw filing clamp to be used in a bench vise.

Before being filed, a circular saw must be jointed or made perfectly round. Place it on the arbor and adjust until a little less than flush with the table top. Start the machine and push a piece of wood over the throat or slot; the saw should just touch the wood. Then, pass a file over the slot as in Fig. 1, or use an oilstone or a piece of emery resting flat on the saw table, if preferred, moving it slowly right and left and ahead to insure that the teeth are jointed square across. Stop the machine to inspect the teeth; then raise the saw slightly, start the machine, and repeat the process until the shortest tooth has been barely touched. The glint of the steel on the point of the teeth is your guide.

Remove the saw from the arbor, place it in the vise, clamp it lightly, and if it is either a small rip saw or a cut-off saw, adjust the set as though a hand saw were being set. Bend every other tooth as in Fig. 2; then set the other teeth.

Tighten the wing nut a little and use the *flat* file to file the face or front of the top tooth which is set toward the farther side. As shown in Fig. 4, carry the file level as at *D* and squarely across as at *E*. Take off enough to brighten the front angle, and file the back (or the top, if you wish to call it that) of the same tooth until the jointing light has disappeared, but not a stroke more. In doing this, point the file upward about 6° or less as at *F*. The file may be carried at about the same angle across as that shown at *G*, although many filers move it squarely across.

Push the saw around and file the next tooth which is set toward the farther side. When all the teeth on one side have been filed, turn the saw around and file those skipped before. In doing this, the angle *F* should be maintained, while the angle *G* should point toward the right.

In filing rip saws less than 9 in. in diameter, the rounded gullet is not as important as in larger saws, although rounding the gullet with a round file makes a better looking job of filing. Many filers use a regular *taper* saw file, 10 or 12 in. long, for small saws, for it will cut the back of one tooth and the front of one behind it down to the gullet at the same stroke as shown at *H*, just as in filing a hand saw. The corner of such a file is broad and makes a gullet that is not too sharp. For large saws, a flat file with a rounded edge is often used. Carry the taper file squarely across as at *E* and tipped up as at *F*.

In conditioning a cut-off or gaining saw, the method of jointing and setting is the same. In filing, however, while the horizontal angle of the stroke is as shown at *J*, Fig. 4, the cross angle is made by carrying the file at from 60° to 65° with

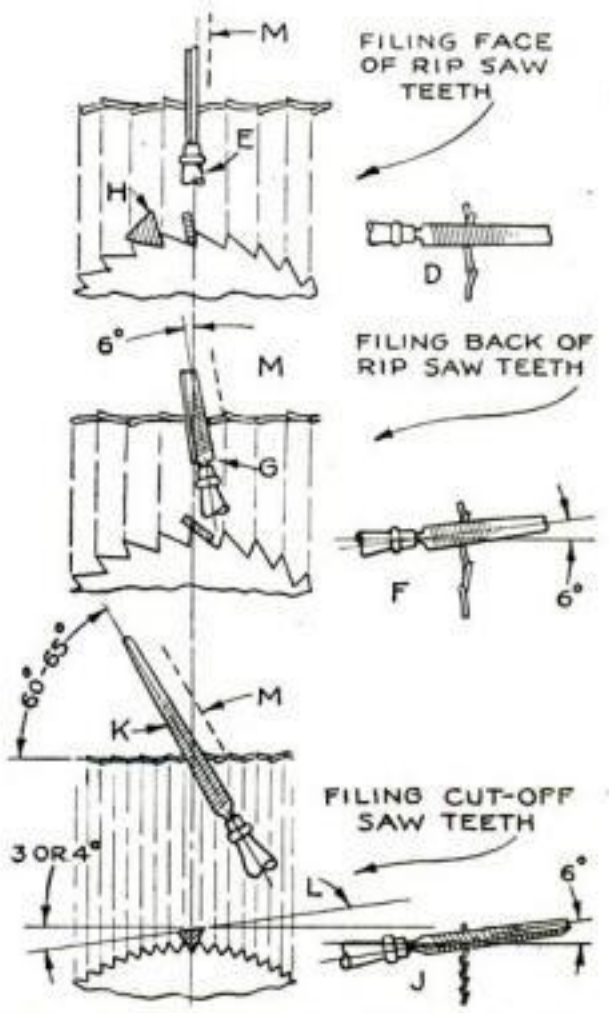


Fig. 4. Diagrammatic sketches showing how the file is held in filing the saw teeth.

the saw as indicated at *K*. The angle must be uniform throughout.

The chief difficulty in filing a cutting-off saw is to maintain the teeth of uniform size and shape. The tooth being filed should be at the top of the saw so that the 3° or 4° angle *L* can be maintained. A line drawn as at *M* will help in checking the cross angles.

Half of the jointing light on each tooth should be removed from each side. The jointing light should be removed, but not a hair more.

The Secrets *of* Mask Making

How to prepare gorgeous false faces for use as decorations or in theatricals and entertainments

THESE MASKS are the product of the fertile imagination and artistic skill of Nat Lichtman, a young Russian artist now living in Brooklyn, N. Y. The mask at the right is a Negro type; the one below is a grotesque; and that on the left is a young Talmudic student. Mr. Lichtman's designs occupy a high place in the fields of both allegorical stage composition and home decoration, and deserve studying.

By
KENNETH M. SWEZEY

BEFORE men made idols, they made masks. It gave them a great sense of primitive power—the power to create new faces that could transform a man in a twinkling to god, beast, or devil. As if by magic, they could emphasize a hundredfold any human mood and bring to real existence the strange and colored caprices of their imagination.

At first the mask was of religious significance; but the early Greek dramatists recognized its unique ability to express and sustain intense emotion, and it was drafted into the theater. From this rich background of religious and theatrical tradition, we inherit the masks of the dance, stage, festival, and party that still charm us today.

Although most of us have enjoyed wearing masks at one time or another, few have attempted to make them. Yet mask making is a fascinating project for any society, school class, or dramatic club which needs them for its entertainments; and, indeed, for individual workers who realize what gorgeous ornaments they make when worn at a costume ball or hung in an appropriate setting in the home.

The fact that much better masks can be made than the usual insipid, characterless productions which are sold has not been generally realized. No doubt this has been due to the scarcity of detailed information on this subject. Anyone who wants to, however, can make as good, or better, masks than can ordinarily be bought. With special skill, care, and imagination, the making of masks may lead further to surprisingly artistic results.

The method to be described is not the only one, but is perhaps the easiest and most satisfactory for the serious beginner. The form of the mask is first modeled in a so-called "plasteline" type of nonhardening clay, obtainable wherever artists' supplies are sold. A mold is made of this model in plaster of Paris; strips of paper are soaked in a thin solution of glue and paste, pressed carefully into this mold, and allowed to dry; finally the paper is removed (now stiff and holding the exact imprint of the mold), and painted as desired. The modeling clay may be used over and over again for new masks, and many masks may be made in the same plaster mold, each being given a different character by the painting.

Materials needed include: several sheets of newspaper, several more of medium weight wrapping paper, 4 oz. of ground or flake glue, 3 lb. of modeling clay, a little flour, a few pounds of plaster of Paris, and paint for coloring the masks. The paint required depends upon the effect wanted; almost any variety—artists' oil colors, brushing lacquer, show card colors, or dry colors mixed with shellac—may be used.

Before attempting to make a mask, however, the character of the face must be clear in your mind. Study human faces and the pictured faces of gods and demons. Observe foreheads, eyes, noses, mouths, chins, and lines of mirth, sorrow, anger, scorn. Notice how women's faces differ from men's, and how the faces of youth differ from the faces of old age. Recognize the vast range of expression from which you may draw.

Then decide just what you wish to express in your mask. Is it fierceness? Nobility? Tragedy? Amusement? Determine an arrangement of features which most strongly suggests the mood of the mask. Make a thumb-nail sketch, if you wish. Whatever you do, do not merely copy life. Masks should show imagination, a real spirit of creation. Arch the brow a little higher, extend the nose, bulge the cheeks, leave out meaningless details. Picture a suggestive face—symbolic, fantastic, if you will.

With the design settled, begin the modeling. A small drawing board, protected with a sheet of stout paper, makes a good base to work on. The amount of modeling material needed depends upon the size of the face to be made and the ingenuity of the maker in padding it out with blocks of wood or other material. A pile of oval or rectangular slabs cut from a corrugated pasteboard box, diminishing in size from the bottom up, forms a satisfactory padding.

Squeeze the modeling clay into an oval pancake about ½ in. thick and press it firmly over the mound of padding. Then begin to mold the substance gradually into shape. Work first for general form, leaving the details until the last.

Most of the modeling may be done with the unaided fingers, but an orangewood stick such as is used for manicuring will help, as will a homemade modeling tool

In making masks the main thing is to use your imagination and work with boldness and vigor. This is true both in respect to preparing the original model of clay, as shown at the left, and in the painting, as above.

A plaster mold is made from the clay model and strips of newspaper are pressed into it.

like that shown in the illustration below.

Cut off material here, apply it there. If you are in doubt about the general shape of an eye or a nose, look in a mirror. Even the eyes and nose of a hobgoblin are remotely related to the real thing. Avoid tiny lines, for they will be completely lost when seen from a distance. Do not make the mask too shallow.

If a particular person is to wear the mask, it is well at the start to make sure that the mask will be large enough and that the eye holes—and, if the person must speak, the mouth hole—are in the proper place. It is disconcerting to an actor to have to look against a blank forehead and talk into a chin or a nose. For speaking masks, separate the lips slightly. Small eye holes may sometimes be cut in other parts of a mask above or below the mask's regular eyes.

Avoid undercutting as much as possible; if undercutting extends beyond a certain degree, it will be difficult or impossible to remove the mask from its mold.

After completing the model, grease the surface of the modeling clay carefully with vaseline, going into all the corners and crevices but taking pains not to clog them. Then quickly mix some plaster of Paris with water to a consistency just thin enough to run easily. About 3 lb. of plaster is sufficient. Apply a coating over the whole surface of the greased model to a thickness of nearly an inch. Blow the mixture vigorously into any deep lines or crevices.

When the plaster has set (which should be in about from twenty to twenty-five minutes), the mound may be turned over and the modeling clay withdrawn. This should come out very freely, but it does not matter if it gets deformed in the process since the model is no longer needed. If there are any little holes in the mold, plug them with clay.

Now give the mold a thin coat of vaseline, and it is ready for shaping the mask.

Into 1 qt. of water stir 4 oz. of ground or flake glue and 2 tablespoonfuls of flour. Boil for two minutes. Tear a quarter of an ordinary sheet of newspaper into strips and patches—say ½ in. wide and 3 in. long—and immerse these scraps in the glue-paste water. When the water has sufficiently cooled, begin to press the strips of paper into the mold. Let one slightly overlap the next, and continue until the pieces cover the inside surface.

Press each piece of paper in carefully, so that it clings to every elevation and depression. Permit no wrinkles. You will find that torn edges cling and blend better than cut ones. If there are any pools of water after you have made a layer of paper, sop them up with a cloth.

If you can find a pink or a green sheet of newspaper, [illegible]

How the clay is built up; how to fit a ma[sk] to the wearer; and a homemade modeling too[l]

well, it is too weak and brittle when it is dry to form a durable mask, therefore the third and subsequent layers should be made of medium weight wrapping paper.

The mold and mask should now be set aside to dry. Warm and freely circulating air will hasten the drying; but baking the mask or setting it on a radiator is apt to be dangerous because of the uneven [illegible] or is

Kinks That Simplify Auto Jobs

Runway for Working Under Car—Foiling the Tire Thief

MANY jobs on the front or rear running gear of an automobile are awkward because there is so little room to work. A pit solves the problem but is not practical for many owners.

A good solution is shown in Fig. 1. Short, strong runways are constructed from sections of two by four and two by six inch lumber. The angle of the approaching incline can be quite sharp. The runways must solidly support the weight of the car. Use heavy nails or No. 18 wood screws. If the incline is made steep it will be necessary to provide stops to keep the elevated platforms from sliding. Be sure to block the rear wheels when the front ones are elevated. Stored with their sides to the garage's rear wall, the runways will take little space.

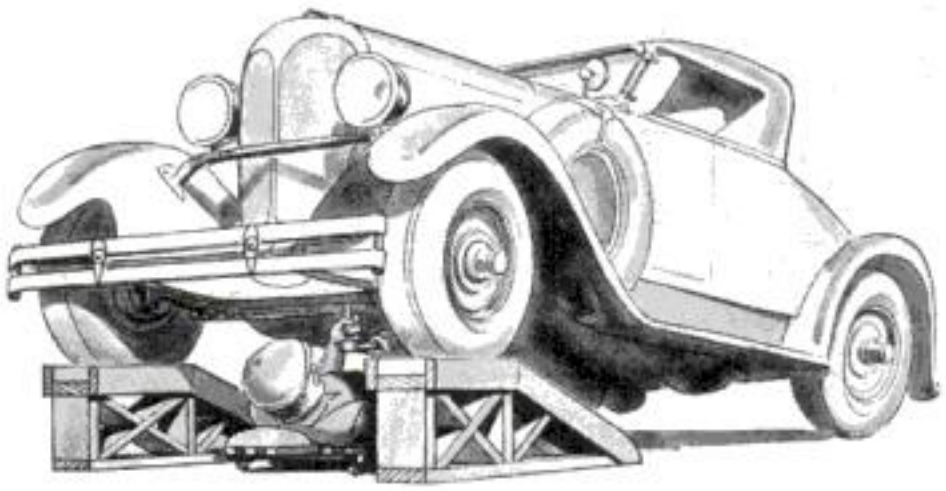


Fig. 1. By building a solid runway that will support your car it is possible to do work beneath it at your ease.

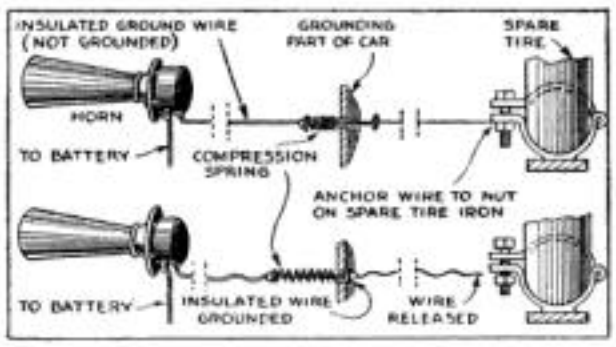


Fig. 3. This thief alarm can be adjusted to any car and will sound if spare is removed.

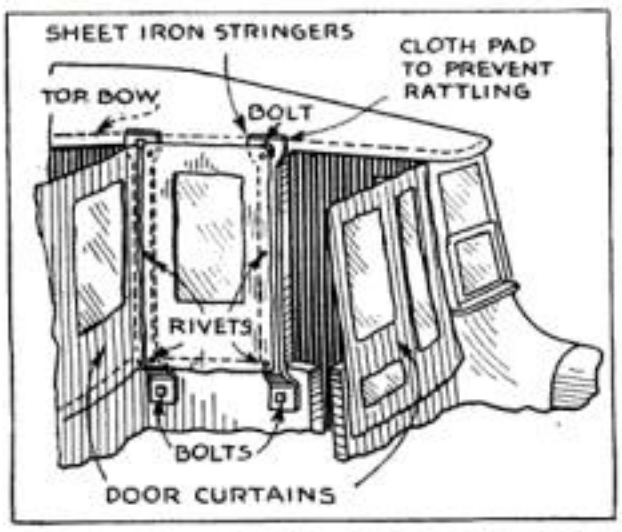


Fig. 2. Front ed[illegible] f[illegible] can b[illegible]

ALARM PROTECTS SPARE

FIG. 3, above, shows an excellent way to protect the spare tire from theft. It operates electrically so that if anyone attempts to remove the tire the horn will start to blow and keep it up till shut off by the owner. The exact details of installations will, of course, depend on the type of car and the method of carrying the spare tire. When the string under the bolt head is released, the spring pulls the washer against the metal of the hole and completes the circuit.

"BLIND" BUSHING

IT IS often extremely difficult to remove a bushing from a "blind" hole. A method often recommended is to run a tap into the bushing which will cut threads so that a bolt can be screwed in. Force can be applied to the projecting head of the bolt and so pull out the bushing. However, Fig. 4, below, shows a simpler and quicker way to do the job. First fill the bushing solidly with soft cup grease. Then take a bolt or a piece of cold rolled stock that makes a fair sliding fit in the hole. Start this in the hole on top of the grease and give it a sharp blow with a hammer. The sudden pressure on the hidden end of the bushing will start it out of the hole.

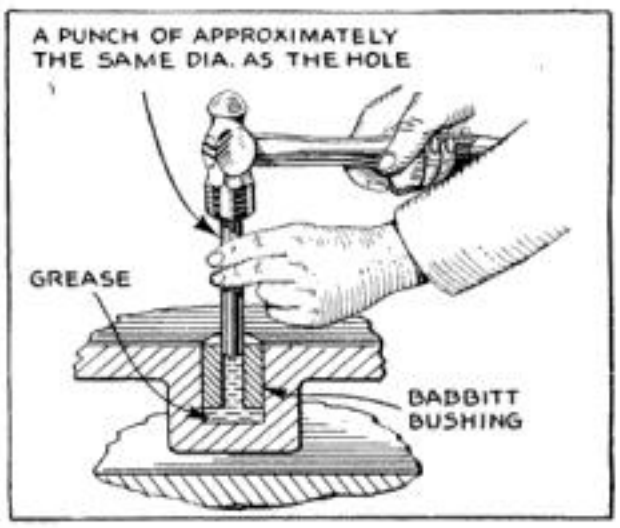


Fig. 4. By filling with grease and using bolt, bushing in blind hole can be removed.

ELECTRIC DOOR SIGNAL

A DOOR not properly latched may swing [illegible] a serious accident, especially [illegible] children in the car. And [illegible] rear seats are unoccupied, [illegible]oor may collide with a post [illegible] the garage and be torn off [illegible]ted.

[illegible] the left, shows a way to [illegible]or indicator that will show at [illegible]hether all the doors are locked [illegible]he idea is to install in each door [illegible]uch as is fitted to the house door [illegible]lar alarm system.

[illegible]witch can be set into the door so [illegible]s operated by the latch as it sinks [illegible] strike plate or by the door edge [illegible]eaches the closed position. The [illegible]laborate method is to install a sep-[illegible]eweled light on the dash for each [illegible] but it is also possible, by wiring [illegible]witches in series, to fix things so that [illegible] one light is necessary. In that case, [illegible]ning any door will cause the light to [illegible]w. Use burglar alarm switches closing [illegible]en the button is released or any sim-[illegible]e switch of spring temper sheet brass.

Shaping Form Tools on Grinder *to Cut Shop Costs*

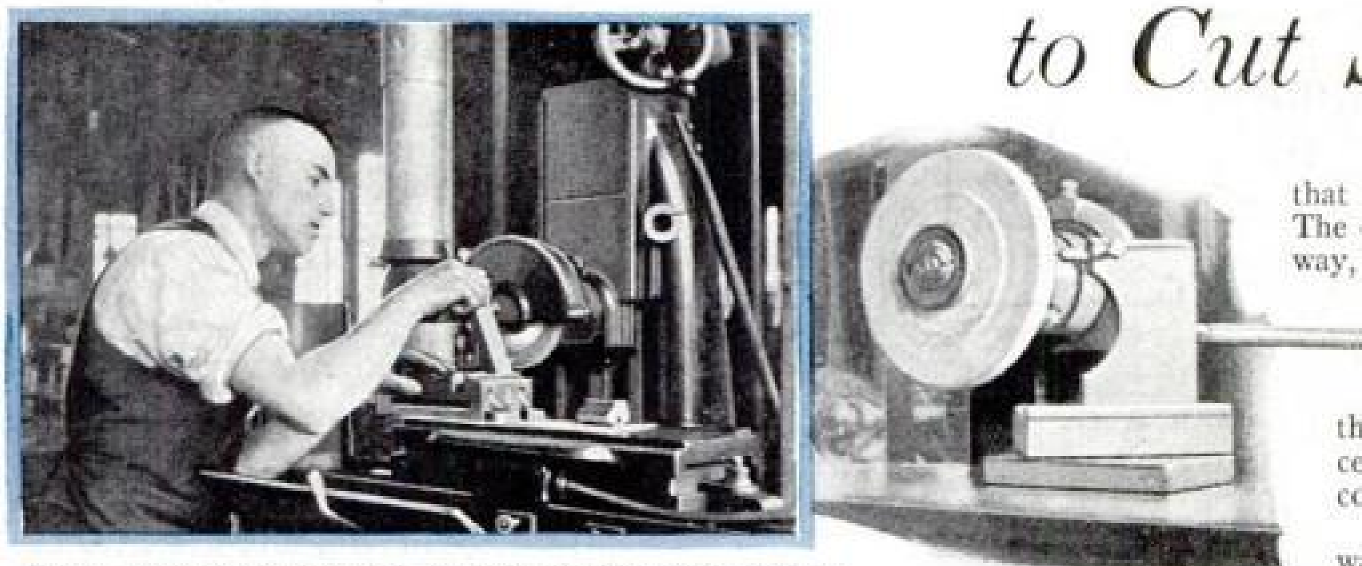


Fig. 1. The author adjusting the angle forming device prior to shaping a wheel *(above)*. The radius forming fixture *(at right)*.

By HECTOR J. CHAMBERLAND

IN THE small machine shop which has only a small volume of production, forming tools must be made quickly, easily, and—above all else—inexpensively. In the larger plants these tools are made from a master former, but in shops of smaller size a more economical method must be used in order to keep down the cost.

While the regular milling cutter system of making forming tools is not to be criticized, the writer has found that the milling operation is expensive at best, especially when it is compared with the cost of surface grinding. Even when the work requires to be roughed out partly on the shaper, form tools can be made by grinding at half the cost of milling.

In shops where form grinding is to be done, a complete set of grinding wheels should be reserved for this purpose. These wheels should be of good quality. The ordinary wheel for the surface grinder has a 1/2-in. face. In the plain style wheel the face may be as wide as 3/4 in. It is customary to have at least three or four wheels with faces 3/4 and 1 1/2 in. wide and with countersunk or recessed holes. These will produce practically any concave or convex radius found on the general run of forming tools.

Before attempting form grinding, it will be well to decide which wheels will be best suited for the work at hand. Alundum wheels (46 I), or their equivalent, are best for radius work over 1/4 in. This type of wheel can be used for both roughing and finishing work of large radius. For radii under 1/4 in., use a 46 J wheel. For work under 1/8 in. a 60 J wheel will give the best results.

To form angles, the allowable width of a wheel depends on the acuteness of the angle to be ground. In case no wheel on hand will take the full angle desired, two cuts can be taken. For this operation, as well as for straight cutting, a 46 J wheel is the best for roughing and a 60 I wheel for finishing. For straight cutting only, a wheel with a 1/4-in. face will give better results. If a combined angle and a flat or a double angle and a flat are desired, a wheel of suitable width must be used. If square corners are called for, an 80 I wheel should be used in finishing.

As a safety measure, wheels with faces up to 3/4 in. in width should not be over 6 in. in diameter, and those with faces over 3/4 in. wide should not exceed 5 in. Any wheel with less than a 1/4-in. face should never be dressed thinner than 1/8 in., and the recess should not extend any farther back from the edge than is necessary to make the cut. All wheels used for straight cutting should be concaved slightly to within 1/16 of the cutting edge. This should be done after the sides and face have been dressed.

In order to grind forming tools, suitable devices for forming angles and radii on the wheels must be on hand. The angle forming device shown in Figs. 1 and 2, which has previously been described (P. S. M., Sept. '27, p. 78), has been found by the writer to have a wide range of service. The radius forming fixture shown in Figs. 1 and 3 is of plain design and is so arranged that it will take any concave or convex surface. It may be set at any angle on the magnetic chuck to form a radius on either side of the grinding wheel, or may be used to obtain a circular segment on the sides of the whe-' as in the gea- form as shown 4. Both of the tures were mad machine steel were not heat treat

The two turr lathe tools X and shown in Fig. 4 are good examples of what can be accomplished through grinding. Both tools were made recently by the writer to replace a set that had been in use for several years. The old tools had been made in the usual way, but had never been ground after hardening. The new tools were roughed out first on the shaper and then roughed and finished by grinding. On a comparison of these operations, a saving of 42 percent was shown with grinding, and, of course, a better finish was obtained.

The procedure in making these tools was as follows: After cutting the stock to the general dimensions, the pieces were surfaced and squared on the surface grinder with a 46 J wheel. This operation in the past had generally been done on a shaper, but grinding proved to be much quicker. The 9/16-in. recess on the tool Y was, however, cut on the shaper. After surfacing, the tools were given a coat of coppering acid, and the desired forms were transferred to the stock from templates. The shaper was used to rough out the shape as indicated in Fig. 4. The tools were then ready for grinding.

To obtain the radius on the side of the tool X, a wheel with a 1 1/8-in. face was

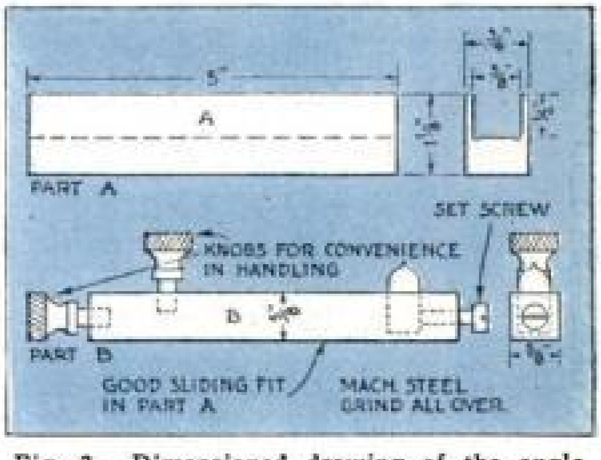


Fig. 2. Dimensioned drawing of the angle forming fixture. Note knobs for handling.

used. After dressing it true, a full 7/16-in. radius was formed. Since D drops 1/4 in. from the top of E, the inner flat of the wheel was dropped 3/16 in. so ·' both D and E could be groun-' setting of the wheel, main- in. drop. After chang- with a 1/2-in. fa- and grain. '' B and T'

... dim... main... stock w... E (and... required ... procedure ... ing tool Y.

Next month, th... will continue the co... form tool grindin... will outline the ... two sizes of intercha... ers for forming tools, ... for grinding threading shape, and a holder for t... tools.

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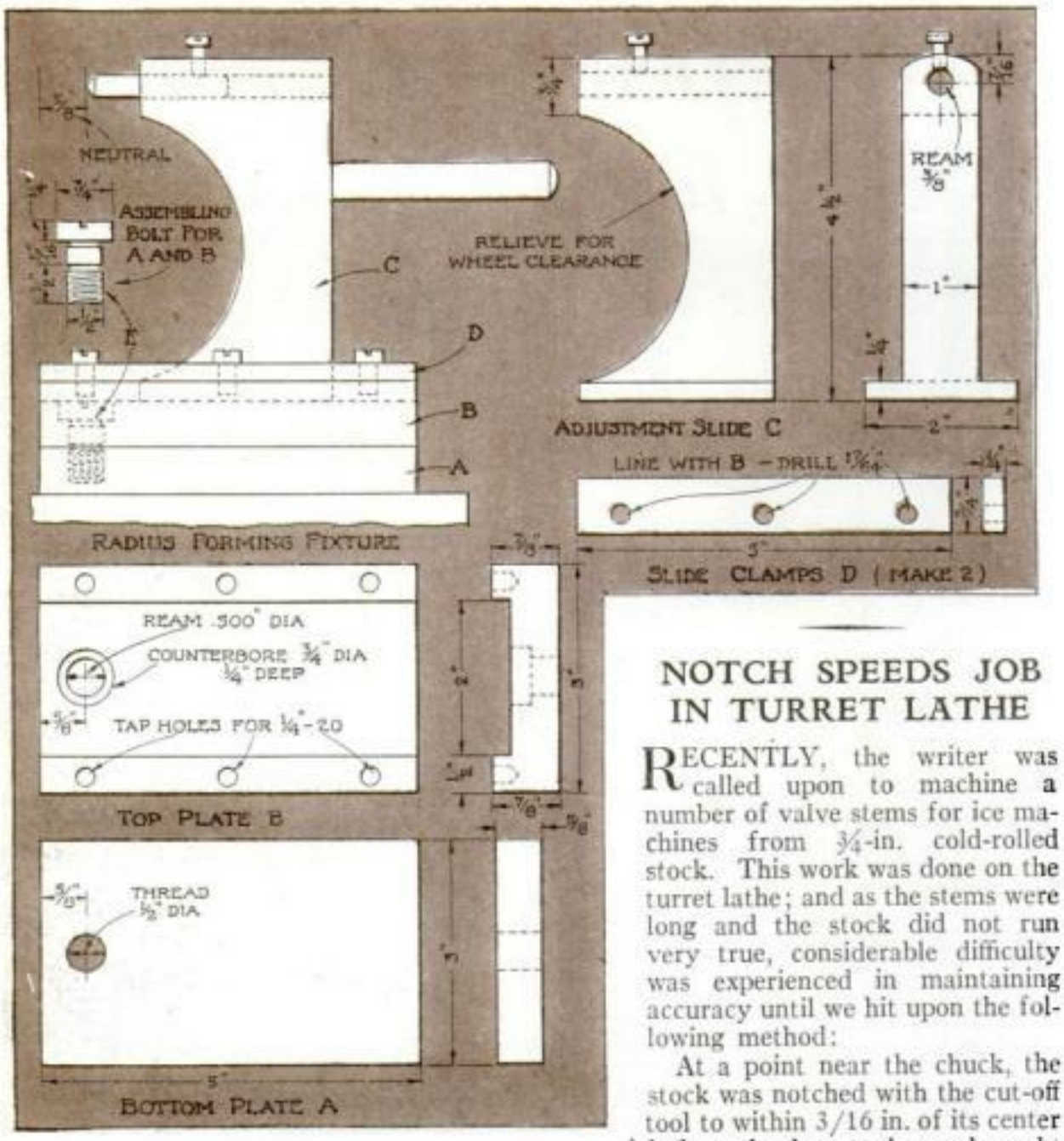


Fig. 3. Assembled view of the radius forming fixture and detailed views of the parts.

hardened and returned for the finishing.

The final grinding operation was identical with the roughing operation. The radius wheels were re-dressed slightly and used for the finishing. It is always advisable, however, in finishing angles on hardened steel, to use a wheel at least one grade softer than that used for soft steel. In finish grinding, do not remove more than .002 in. at a time, otherwise you will be running the risk of forming wheel cracks which may not become immediately visible.

In finishing, the dimensions must be checked up carefully. On tool *X* the .015-in. allowance between the roughing and finishing made it possible to get the desired 25/32-in. dimension by removing .015 in. from the side *A* of the ...ool. The finish grinding of the ...dle took care of the 9/64-in. ...nsion; and since the wheel ...ained the ¼-in. drop, enough ...s removed from the radius ...of course, *D*) to get the ...1/16-in. step. The same ...as followed in finish-

...Mr. Chamberland ...s discussion of ... methods and ...struction of ...reable hold- ... novel jig ...tools to ...reading

NOTCH SPEEDS JOB IN TURRET LATHE

RECENTLY, the writer was called upon to machine a number of valve stems for ice machines from ¾-in. cold-rolled stock. This work was done on the turret lathe; and as the stems were long and the stock did not run very true, considerable difficulty was experienced in maintaining accuracy until we hit upon the following method:

At a point near the chuck, the stock was notched with the cut-off tool to within 3/16 in. of its center before the box tool was brought into position for the rapid turning cuts. This reduced the undesirable rigidity of the stock and gave a partial floating effect, reducing the number of adjustments necessary to a minimum. After using the cut-off tool in this manner, we obtained exceptional accuracy and increased production 30 percent. The time spent in notching the work with the cut-off tool was more than counterbalanced by the increase in production and the added simplicity of the operations.—ALLAN B. SHAW.

Old Bill *Says...*

WHEN drilling overhead, half of a hollow rubber ball slipped over a drill will serve to catch the chips and prevent them from falling on your face and into your eyes.

By painting a red stripe around the shank of your high-speed drills, you can easily distinguish them from your carbon drills.

Rubber pads placed under the supporting feet of high-speed machines will eliminate a large portion of the vibration and chatter.

When making interchangeable drill jig bushings, knurl the drill bushing and supply the reamer bushing heads with a hexagonal shape. The difference in treatment will allow them to be quickly distinguished from one another by the operator.

When a tap breaks in a piece of work and it is impossible to remove it except by the annealing and drilling method, tap the remaining holes first; then if another tap should break only one annealing operation will be necessary.

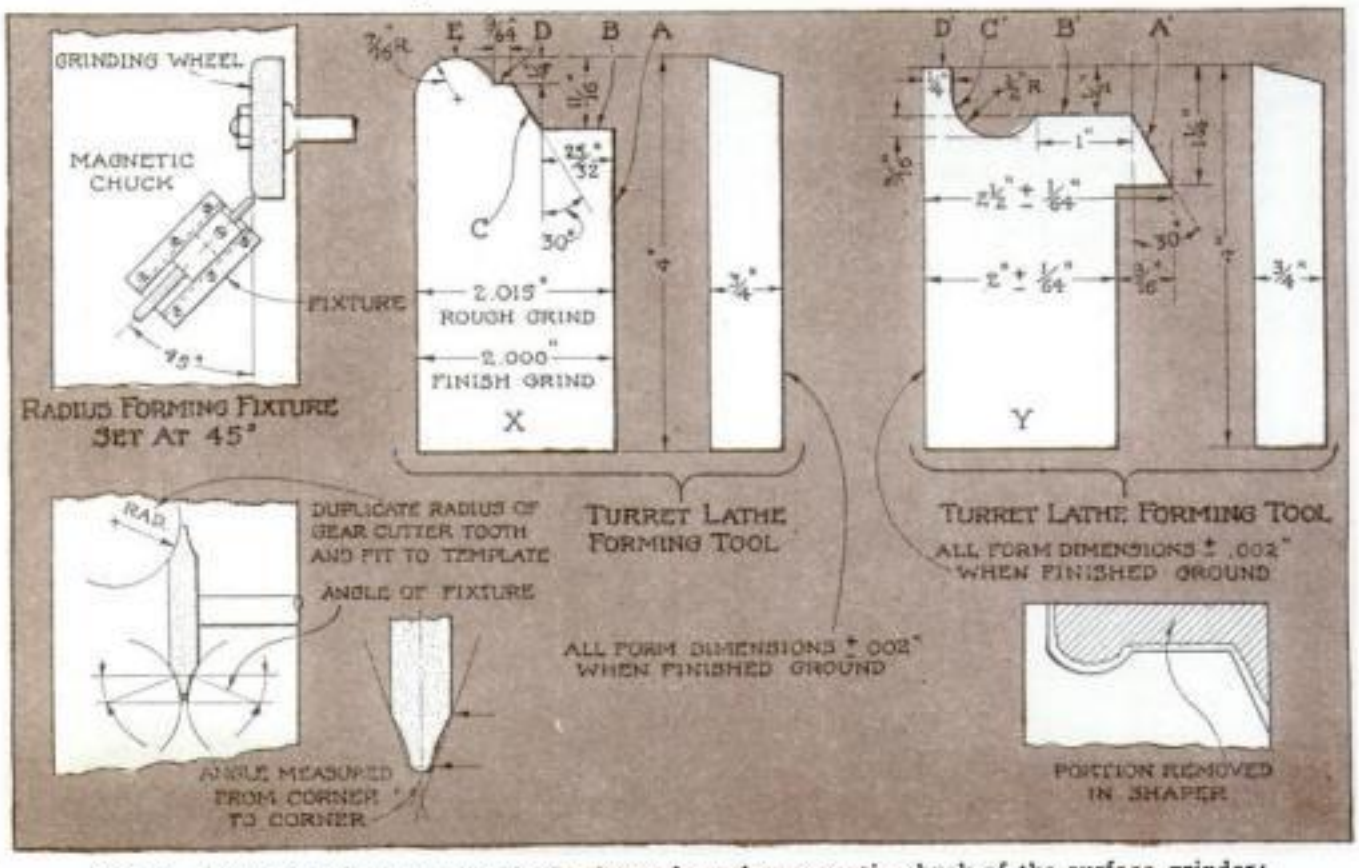
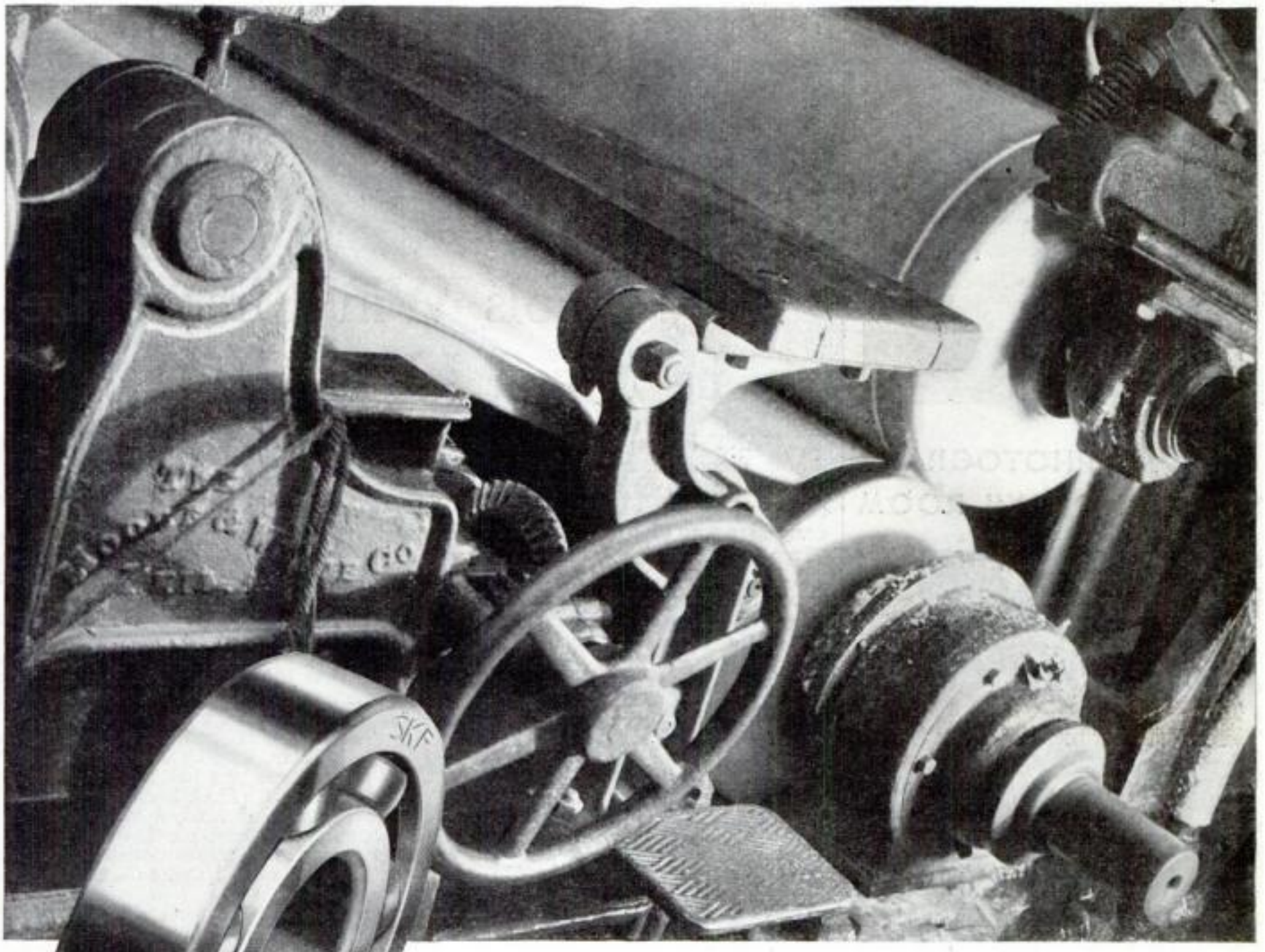


Fig. 4. How the radius forming device is used on the magnetic chuck of the surface grinder; a gear form; and two turret lathe forming tools (*X* and *Y*) that were ground to shape.

MEN WHO MAKE PAPER *KNOW* IT TOO!

SKF equipped Moore & White Company paper making machine in the plant of the Dill & Collins Company, Philadelphia, Pa.



IN A BEARING THERE'S NOTHING BUT PERFORMANCE THAT COUNTS

MEN who make paper know bearings. Paper, whether it is fine, coarse or just in between, *depends* upon bearings. Bearings are a part of the job...from pulp to finished product . . . and SKF Bearings...invariably.

For in the bearings used in paper making machinery, performance is the only thing that counts. And that means SKF.

SKF Bearings are built for performance. Performance is the only excuse for their existence. Performance is the reason for their selection wherever the job is toughest or the going hardest. Such bearings as SKF are never built *down* to a price. They are built *up* to the job . . . always.

In a bearing, performance is the only thing that counts.

Think over this little morsel of horsesense when it comes to bearing selection and you are tempted by a lower price—"It costs more to replace a poor bearing than to buy the best bearing that SKF ever produced."

SKF INDUSTRIES INC., 40 EAST 34th ST., NEW YORK, N. Y.

SKF

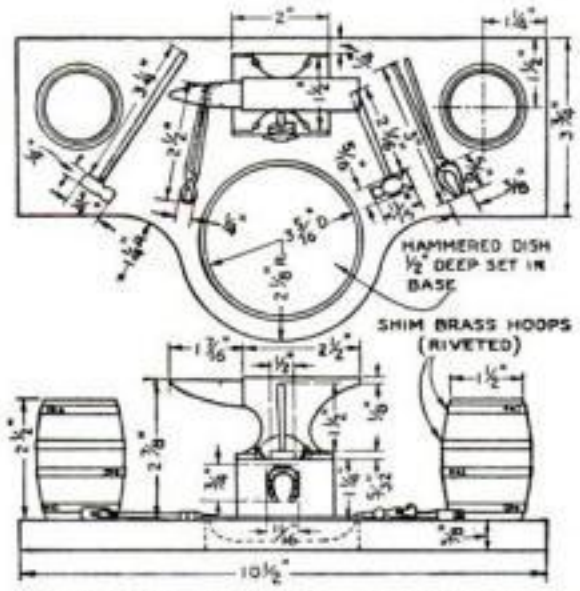
BALL AND ROLLER BEARINGS

2714

Tiny Tools Win First Prize in Novel Ideas Contest

MANY letters suggesting ideas for decorative, story-telling novelties that can be made at home were submitted in the contest announced in connection with Charles H. Alder's article, "Treasure Island Smoker's Tray" (P. S. M., Apr. '31, p. 87). The complete list of prize winners is given at the bottom of the following column.

Carl Senf, who was awarded first prize, suggested a tray ornamented with a miniature anvil, three tiny hammers, two pairs of tongs, a diminutive horseshoe, and two kegs such as might be found in any old-time blacksmith's shop. The tray is intended to be used either as a smoker's



This drawing duplicates Mr. Senf's except for the lettering, which has been enlarged.

set or as a desk holder for paper clips, pins, and other small odds and ends.

With his letter, Mr. Senf submitted the photograph at the top of the page and a neatly prepared drawing. His letter follows:

Here is my entry in your story-telling novelty contest. It is a reminder of the passing (in fact, almost forgotten) blacksmith shop. The drawing and photo will tell you more about how I made it and what it looks like than I can explain here.

The anvil was cast of brass; it could be cast of lead, or even a wooden one painted a dull black is attractive.

The hammers were shaped by filing the heads from a piece of ¼ in. square brass rod, and drilling a hole about 3/32 in. in diameter for the handles, which can be made of wood or brass rod filed to shape. The tongs were made from ⅛ in. round brass, hammered and filed to shape. A small hole was drilled at the intersection of the two halves for a small pin or rivet.

I hammered the dish to ½ in. depth by 3 5/16 in. diameter, with a ⅛-in. flange around the edge. The flange is used to hold the dish in place.

The kegs were made in much the same manner as the wine cask described on page 88, April POPULAR SCIENCE MONTHLY. I used shim brass hoops. The base is cut to shape from a piece of ⅝-in. mahogany 10½ in. long by 6½ in. wide.

The anvil is mounted on a block 1¾ in. high by 2 in. long by 1¾ in. wide, with four escutcheon pins holding it in place. In the center of the block just under the anvil, the horseshoe is fastened with pins. The hammers and tongs are fastened in place on the base with staples made of bent pins, and the kegs are nailed to the base with small nails.

This novelty will serve either as a desk holder for paper clips, etc., or an ash tray.

The second prize went to William Fitzpatrick for suggesting an ash tray made in the form of a log cabin fireplace. The third prize was won by J. C. Warlick for a design for an aquarium with a model of a wrecked ship lying on the bottom.

WINNERS IN NOVELTY PRIZE CONTEST

First Prize, $25

Carl Senf, Baltimore, Md.

Second Prize, $10

William Fitzpatrick, Yonkers, N. Y.

Third Prize, $5

J. C. Warlick, Spartanburg, S. C.

Ten Prizes of $1

Ralph Allard, Columbus, O.; Burl Knutson, Bismarck, N. D.; Chester Peterson, Hancock, Mich.; Charles J. Rifenberg, Brooklyn, N. Y.; Mowry Ross, Camden, N. J.; Kenneth Schaffer, Allentown, Pa.; J. Sinisi, Jackson Heights, N. Y.; D. T. Stevenson, Anderson, Ind.; Robert O. Stromswold, Mohall, N. D.; Joe Thomas, Tacoma, Wash.

Snapshots!..$100,000 for Snapshots

Big Cash Prizes Offered for Pictures in Kodak's International Competition

The owner of a Brownie, a Hawk-Eye, or the simplest Kodak has the same chance as users of costly cameras.

SNAPSHOTS made at home . . . snapshots made on your vacation! Snapshots of places or people or things! They all stand a chance to win a big prize in Kodak's $100,000 Competition.

1,000 prizes for U. S. A.

There are 1,000 prizes, totaling $25,000, for pictures from the United States alone. And first-prize winners in U. S. A. compete for international awards amounting to an additional $16,000.

A single simple snapshot may win you as much as $14,000.

Only amateurs may compete, any picture subject may be entered, and the user of an inexpensive camera is on the same footing as the owner of a costly outfit.

Celebrities to be Judges

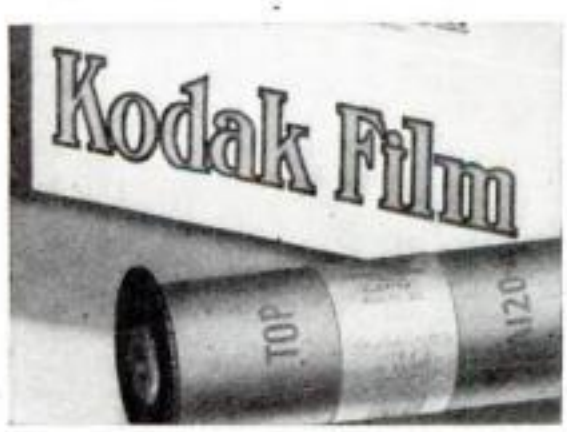
Winners of the U. S. prizes will be determined by a committee of distinguished judges consisting of Rear Admiral Richard E. Byrd, conqueror of both Poles by air; Mary Roberts Rinehart, foremost authoress; Rudolf Eickemeyer, eminent photographer; Howard Chandler Christy, celebrated artist; Kenneth Wilson Williams, editor of "*Kodakery*."

Go to your dealer today or write to the Eastman Kodak Company, Rochester, N. Y., for a leaflet giving rules of the contest. Lay in a supply of film. Clip the entry blank at right. And enter to win.

* * *

Tune in for news of the contest over the N. B. C. Red Network every Friday at 10 p. m. Eastern daylight saving time. Pacific Coast program, 9:30 p. m. Pacific time.

Any amateur eligible, with pictures made in May, June, July or August, 1931. Your simplest picture may win you as much as $14,000.



Kodak Film in the familiar yellow box, or the new Kodak Verichrome Film in the yellow box with checkered stripes . . . gives pictures of the prize-winning kind.

$25,000 *in* U. S. Prizes

SIX PICTURE CLASSES

1,000 Chances to Win!

YOU may submit pictures of *any* subject in this contest. Prizes will be awarded in 6 classes, and your entries will be placed for judging in the classes in which they are most likely to win.

A. *Children.* Any picture in which the principal interest is a child or children.

B. *Scenes.* Landscapes, marine views, city, street, travel or country scenes, etc.

C. *Games, Sports, Pastimes, Occupations.* Baseball, tennis, golf, fishing, gardening, carpentry, etc.

D. *Still Life and Nature Subjects, Architecture and Architectural Detail, Interiors.* Art objects, curios, cut flowers, or any still life object in artistic arrangement, any nature subject, etc. Exteriors or interiors of homes, churches, schools, offices, libraries; statues, etc.

E. *Informal Portraits.* Close-up or full figure of a person or persons, excepting pictures in which the principal interest is a child or children. (See Class A above.)

F. *Animals, Pets, Birds.* Pets (dogs, cats, etc.); farm animals or fowls; wild animals or birds, either at large or in zoos.

Prizes for United States

GRAND PRIZE: Bronze Medal and . . $2,500

141 PRIZES IN EACH CLASS

For the best picture in each class	$500
For the next picture in each class	250
For the next picture in each class	100
For each of next 5 pictures in each class	25
For each of next 133 pictures in each class	10

(847 prizes, totaling $16,330)

STATE PRIZES FOR CHILD PICTURES

153 state prizes totaling $8,670 are already being distributed for child pictures made and entered in May and June. 141 other prizes for child pictures (see Class A) made in May, June, July and August will be given at the end of the general contest which closes August 31.

International Awards

The best picture in each class from each country automatically enters the International Competition to be judged for later awards at Geneva, Switzerland

GRAND AWARD: Silver Trophy and . . $10,000

SIX CLASS AWARDS: Best picture in each class, a Gold Medal and $1,000

* * *

Total U. S. Prize Money	$25,000
International Awards	16,000
Prize Money for rest of world	59,000

NOTE that one picture may win a $500 class prize, the $2,500 grand prize for U. S. A. . . . plus a $1,000 international class award and the $10,000 international grand award . . . a total of $14,000 for a single snapshot.

Entry Blank — *Clip it Now!*

Mail blank with your entries to Prize Contest Office, Eastman Kodak Co., Rochester, N. Y. Do not place your name on either the front or back of any picture.

Name _____
(Please Print)

Street Address _____

Town and State _____

Make of Camera _____

Make of Film _____ *Number of pictures accompanying this blank* _____

P. S. 8

KODAK INTERNATIONAL $100,000 COMPETITION *for Amateur Picture-Takers*

EDWARD THATCHER *tells how to convert glass jars into*

Decorative Lighting Fixtures

ATTRACTIVE electric lanterns or wall bracket fixtures can be made with very little work and trifling expense from many types of discarded glass containers in which foodstuffs have been packed.

The containers are not cut or altered in any way, but vents are provided in the housing at the top to allow the heat to escape. Even the smaller containers will usually take a 25-watt show case bulb, which is about 1¼ in. in diameter and 4½ in. long, and the larger jars will accommodate a 50- or even a 100-watt bulb.

Four fixtures are illustrated, but it is not necessary to follow exactly any of these designs. Obtain a suitable glass container and then build your fixture to suit it. An excellent method is to cut accurate paper patterns of the various parts, fold them as necessary, and test them before starting to cut out the metal.

The general construction of these lanterns is similar to that described in a previous article (P. S. M., Apr. '30, p. 81). The making of shallow copper or brass bowls such as those used in fixture No. 3 (Fig. 3) also has been covered before (P. S. M., May '29, p. 79). They are formed by beating the metal with an embossing hammer into a depression carved in a wooden block.

The electric light sockets are fastened in each case by using a short threaded nipple and lock nut sold for the purpose. For use outdoors or on open porches, the socket may be mounted as shown in the fixture No. 1 (Fig. 5). The support is made from a short strip of No. 16 gage sheet brass or copper about ⅝ in. wide, in the middle of which is drilled a hole to receive the threaded nipple. Two holes are drilled, one at each end, for the rivets that secure this piece to the top of the ventilator housing.

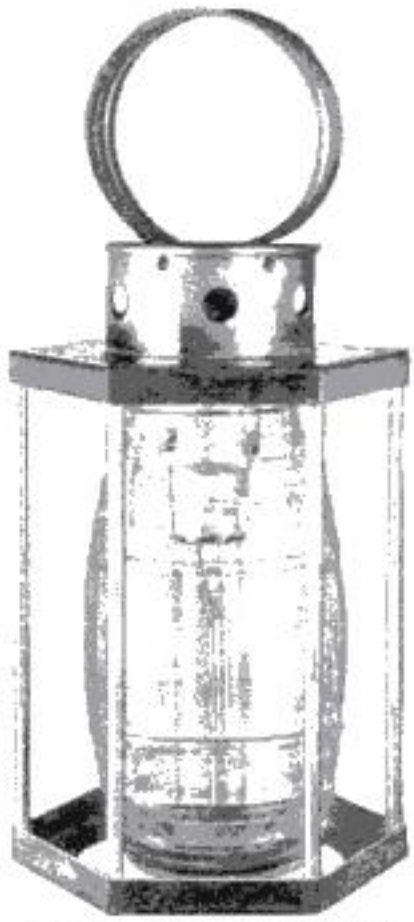
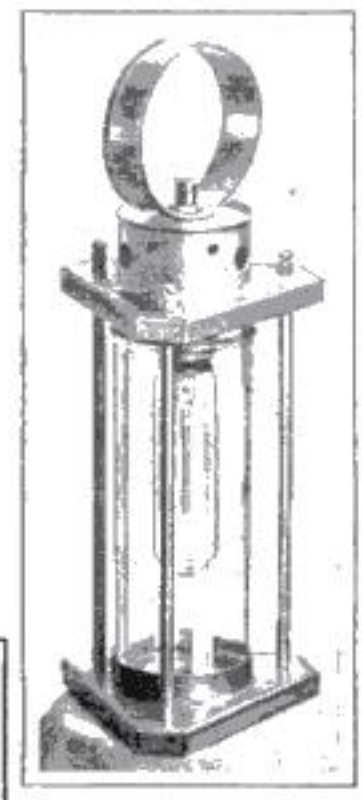


Fig. 1. This artistic lantern shows what the amateur can make out of a discarded olive jar and scrap material.

If the fixture is to be used indoors or on an inclosed porch, the socket may be fastened directly to the top of the ventilator as shown in the drawing of fixture No. 2 in Fig. 5. It is a good plan to study commercial fixtures as approved by the inspector of electric wiring in the district where your home-made fixtures are to be used. All wiring must comply with the National Electric Code and the local building code. Generally speaking, a fixture which is to be used outdoors should be made of brass or copper or some of the new nonrusting metals, but tin, if well painted or lacquered, will last a long time. Plain unpainted tin is attractive when used indoors and is becoming increasingly popular.

Fig. 2. Anyone who can use tools can make the electrified lantern shown below.



To cut an opening in the tin cap of a glass jar, scribe a circle of the required diameter on the inside surface, place the cap upside down on the end grain of a flat block of wood, and use a small, sharp cold chisel. Smooth the cut edges with a fine file. With the cap in the same position, either punch or drill the rivet holes. The central opening in the cap should be slightly larger than the diameter of the socket to allow the escape of heated air. An opening of identical size, of course, must be cut in the piece of metal to which the cap is to be riveted.

The globe of fixture No. 1 (Figs. 1 and 5) is a barrel-like olive jar. The top and bottom are of common roofing tin; the six tin tubes are made from five-cent curtain rods, painted with aluminum to match the tin. The ventilator at the top is part of a soup can.

In this fixture a large circular opening is cut in the bottom of the lantern through which the glass container may be passed to screw it in place. This also allows the light to shine straight down. The ring handle is riveted to the top of the fixture; then the socket support is riveted in place, and a wired socket is fastened as shown, with the wires running out of one of the ventilator holes at the back. The ventilator top is next soldered to the six-sided top, the sides of which are first folded down and soldered at each corner. The bottom piece is prepared in the same way; then the six lengths of tubing are fixed in place with soft solder.

A plain straight-sided glass container which once held mackerel steaks is the globe for fixture No. 2 (Figs. 2 and 5). Its flanged lid originally was secured by a circular clamp. The clamp is discarded, and the flanged top is cut out to admit the socket and is riveted to the triangular top of the lantern. A circular opening is cut in the bottom piece slightly smaller than the diameter of the jar, and a narrow band of tin is soldered on as shown to receive the lower end of the glass.

The top and bottom pieces of the frame are held by threaded curtain rods of the ten-cent variety, each passing through the tubing which comes with the rods. The lantern is as- *(Continued on page 92)*

BLUEPRINTS FOR YOUR HOME WORKSHOP

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....
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Price 25 cents each except where otherwise noted

Name.....
(Please print name and address very clearly)

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Fig. 3. A large cylindrical pickle jar serves as the globe for this copper lamp.

sembled by placing the top of the glass in the original flanged cap and setting the bottom in the ring of tin. Then each length of curtain rod is slid through a tube and held with a nut at the bottom, as indicated.

A large cylindrical pickle jar provides the glass for fixture No. 3 (Figs. 3 and 5). Three shallow bowls comprise the main parts of the frame. These and the supports or guards are made of No. 20 gage copper. The strips for the guards are folded at right angles lengthwise and pointed at the ends. If preferred, copper tubing could be used instead. The ends of the guards are slipped through holes drilled in the bowls and soldered. Copper paint is used to cover the tin screw cap, the socket, and all the visible soft solder.

Fixture No. 4 (Figs. 4 and 5) is made of roofing tin to suit a jam jar with a flanged tin top and a circular clamp. The flanged lid is discarded and the circular clamp soldered for half its length to the underside of the top. This leaves the other half free to spring out slightly to receive the projection at the top of the glass. To hold this side in place, a washer is slipped on a No. 8-32 roundhead screw in such a way that the edge of the washer engages the edge of the clamp when the screw is pushed through a hole punched in the top. A nut from a discarded dry cell battery serves to fasten the screw to the top.

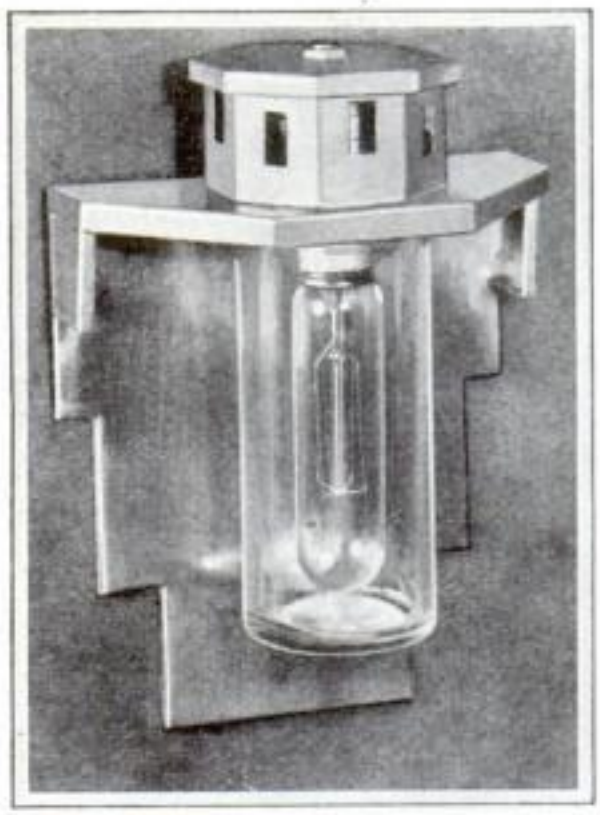


Fig. 4. This artistic wall bracket fixture is made of roofing tin and a long jam jar.

The eight-sided top or ventilator has rectangular vents cut with a sharp chisel. Note how the design of the back plate is brought out and strengthened by folding the edges down at right angles and soldering the joints thus formed. The drawing of this fixture is a combination pattern for the back plate and an assembled view. This method was used to show how the edges of the back plate are cut and bent back at right angles to the front.

PLANE AIDS IN SHAPING THIN ALUMINUM STOCK

IN WORKING thin sheet aluminum, it is often a tedious job to file it to shape because the teeth of the file tend to become clogged and the softness of the material makes it difficult to obtain a true edge. The very fact, however, that aluminum is no harder than some woods allows it to be trimmed successfully with an ordinary block plane. Indeed, aluminum may be easily whittled to shape with a knife, and since it has no grain and will not split, it is preferable to wood for many purposes.—J. V. HAZZARD.

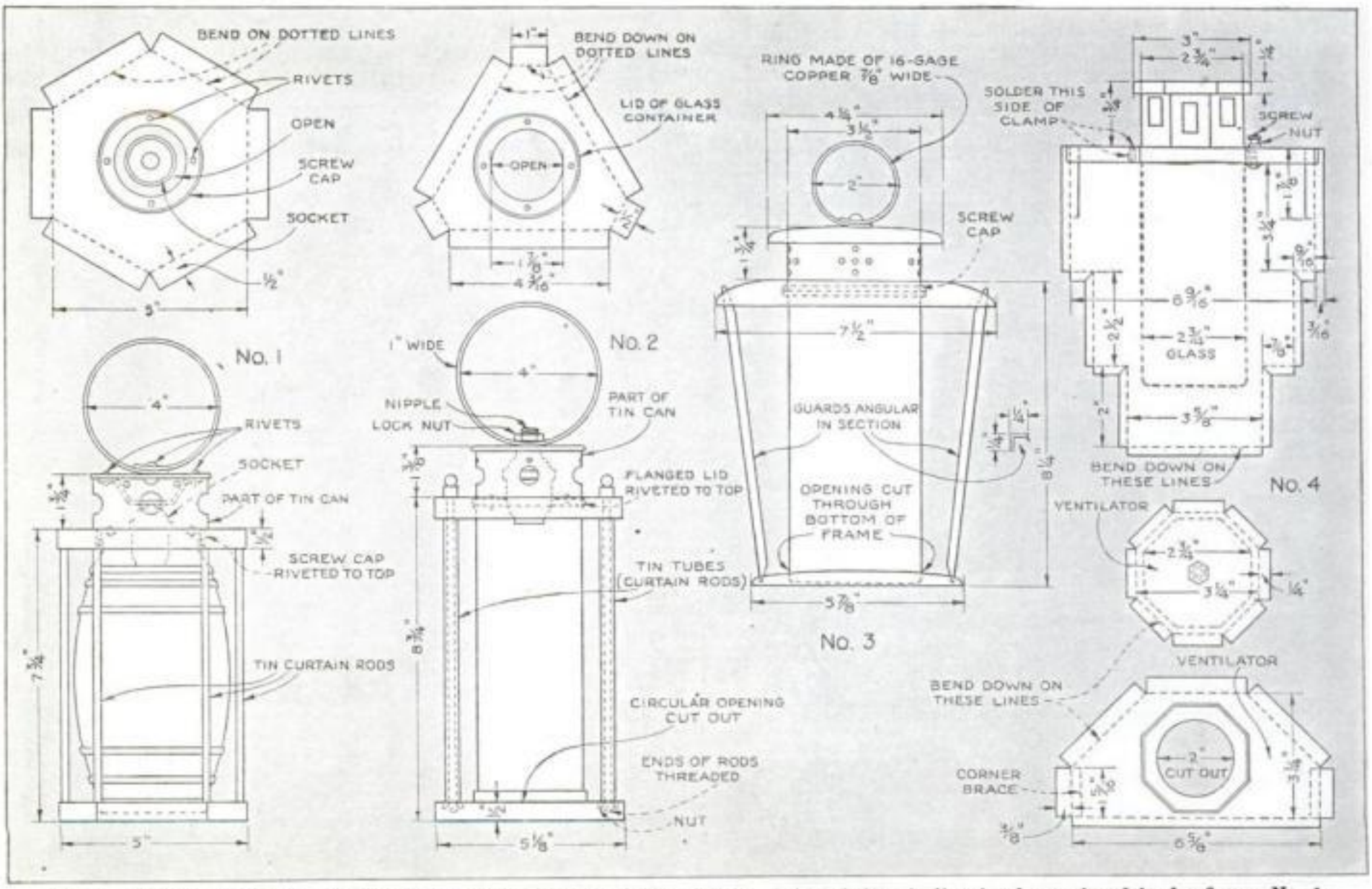
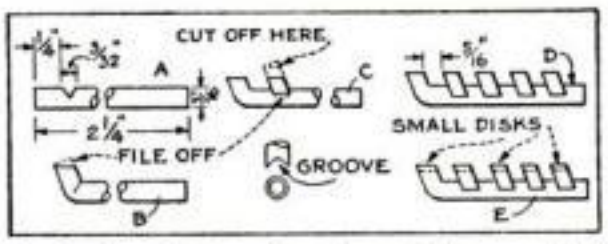


Fig. 5. Four suggested designs for lanterns using old glass jars for globes. A barrel-shaped olive jar forms the globe for fixture No. 1, while a mackerel steak jar serves for fixture No. 2, and a large pickle jar and a jam jar are used in fixtures Nos. 3 and 4 respectively.

MAKING EXHAUST PIPES FOR MODEL PLANES

REALISTIC exhaust pipes for scale model airplanes which have in-line and V-type engines can be made easily from aluminum tubing. My own practice is to use an 8-in. length of 3/16 in. diameter tubing and cut from it two pieces 2¼ in. long. A triangular notch 3/32 in. wide and the same depth is filed in each piece ¼ in. from one end as at *A*, and the tube is bent until the gap is closed. The bent end is then filed as at *B*.

One end of the remaining piece of tubing is now filed to the same angle as the bent end of the main pipe, and the same end is grooved with a rat-tail file so that

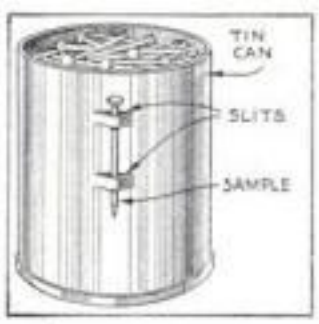


Realistic exhaust pipes for airplane models can be made from 3/16-in. aluminum tubing.

the tube will fit halfway over the manifold as shown at *C*. Hold this tube in place and cut it off even with the bent end. Then make seven more short pieces exactly the same and cement four of them to each of the manifolds, spacing them about 5/16 in. apart as at *D*. Next cement small disks in the open ends of the tubes as at *E*, and fasten the whole assembly to the side of the plane.—HENRY MARTIN.

LABELING CONTAINERS FOR HARDWARE

A SIMPLE way to label tin cans or other metal containers used for the storage of nails, screws, and other hardware is to cut two or four slits in the container and insert one of the nails or screws in the manner illustrated.



Slits in the can hold the sample hardware.

If desired, a strip behind the nail or screw may be painted white as a background. —E. A. BROWN.

TELLTALE REMINDS YOU OF CELLAR LIGHTS

MY BASEMENT workshop is brilliantly lighted by several 150-watt lamps. On several occasions I have forgotten to switch them off, and even a few such nights result in an appreciable addition to my monthly electric bill. As a reminder to prevent further forgetfulness, I attached a bell-ringing transformer (costing only a dollar) to the lighting circuit in the basement, and ran a pair of bell-wire leads upstairs to a miniature lamp socket mounted on the wall near the exit from the cellar stairs. A 6-volt flashlight bulb serves as the telltale.—D. TEMPLETON.

Arrow Making

Simplified for Beginners

By J. G. PRATT

ARCHERY grows in popularity season by season. Many new clubs have been formed, and archers now have every opportunity to indulge in target shooting, archery golf, roving—competitive shooting from one mark to another—and even hunting. Health-giving and muscle-building sport as it is, archery nevertheless is not too strenuous. It can be practiced by men and women of all ages. Furthermore, it is one of the least expensive sports, especially if you make your own tackle as described in this article and one on bows which appeared last month (P. S. M., July '31, p. 86).

Arrows are of two types, those made of one piece and called "self arrows" and those of the better class which are known as "footed arrows" because a piece of hardwood or "footing" is spliced to the softwood shaft at the end carrying the point or "pile," as it is called.

Fig 1. Feather end of a high-grade target arrow with horn nock. Hunters like Art Young *(above)* use heavier arrows.

Fig. 2. Cementing a feather on a shaft with the aid of two pins, which can be manipulated to stretch it very straight.

The quickest way to make self arrows is to use birch or maple dowel sticks 5/16 in. in diameter. They are not so satisfactory, however, as shafts made from Norway pine, Douglas fir, or spruce. When footings are used, they are of beefwood, greenheart, lemonwood, lancewood, straight-grained walnut, or other very hard, strong wood. You can obtain the wood and saw it up

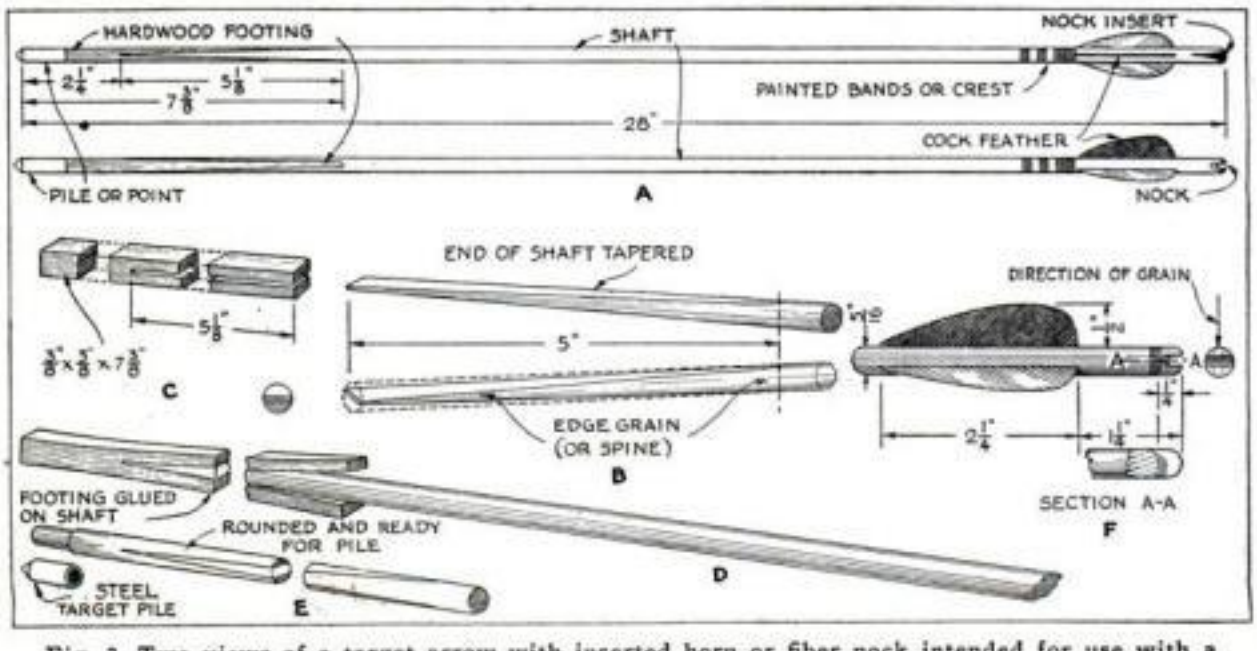


Fig. 3. Two views of a target arrow with inserted horn or fiber nock intended for use with a man's bow (women's arrows are usually 25 or 26 in. long) and details of the construction.

yourself into 3/8 in. square sticks, or buy regular arrow stock from a dealer, together with a supply of metal points and turkey wing feathers.

The method of making a footed target arrow (see *A*, Fig. 3) entirely by hand from square stock will be described. If you understand this, you will have no difficulty in making the simpler types of arrows which have no footings; and, of course, you can do some of the work with machines, if available.

Bear in mind that your success in archery will depend to a considerable extent upon your arrows, which should be as uniform as it is humanly possible to

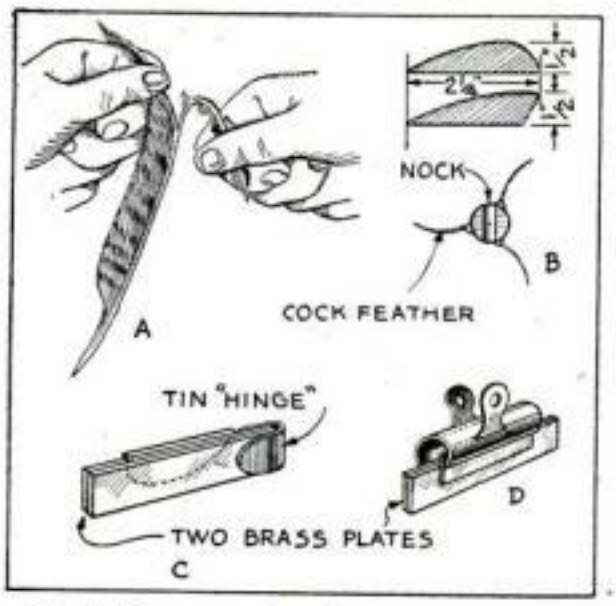


Fig. 4. How to strip a feather, two ways in which feathers are trimmed, and two clamps.

make them in construction, weight, balance, and stiffness or "spine." If any shaft is lacking in spine and does not spring back quickly when bent, discard it. Even in the unfinished shafts, the range in weight should not be more than 10 grains.

Plane the shafts to 3/8 in. square, then to an octagon shape, and finally round the corners until the cross section is approximately circular. A planing guide and a V-shaped jig made as shown in Fig. 5 will simplify this work. The shafts must be perfectly straight.

Scrape the shafts with glass or a cabinet scraper or rub them with sandpaper until you can force them through an 11/32-in. hole drilled in a small iron or steel plate. Then remove all imperfections with grooved sandpaper blocks made as

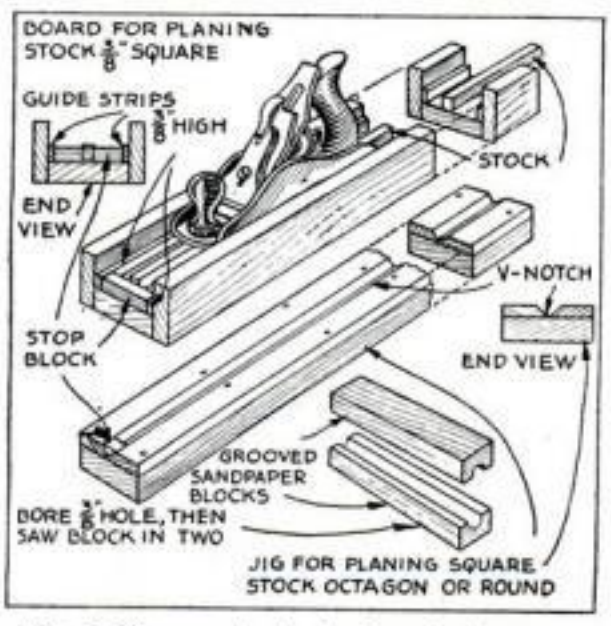


Fig. 5. Homemade planing boards for arrow shafts and a pair of grooved sanding blocks.

A definite program for getting ahead financially will be found on page four of this issue.

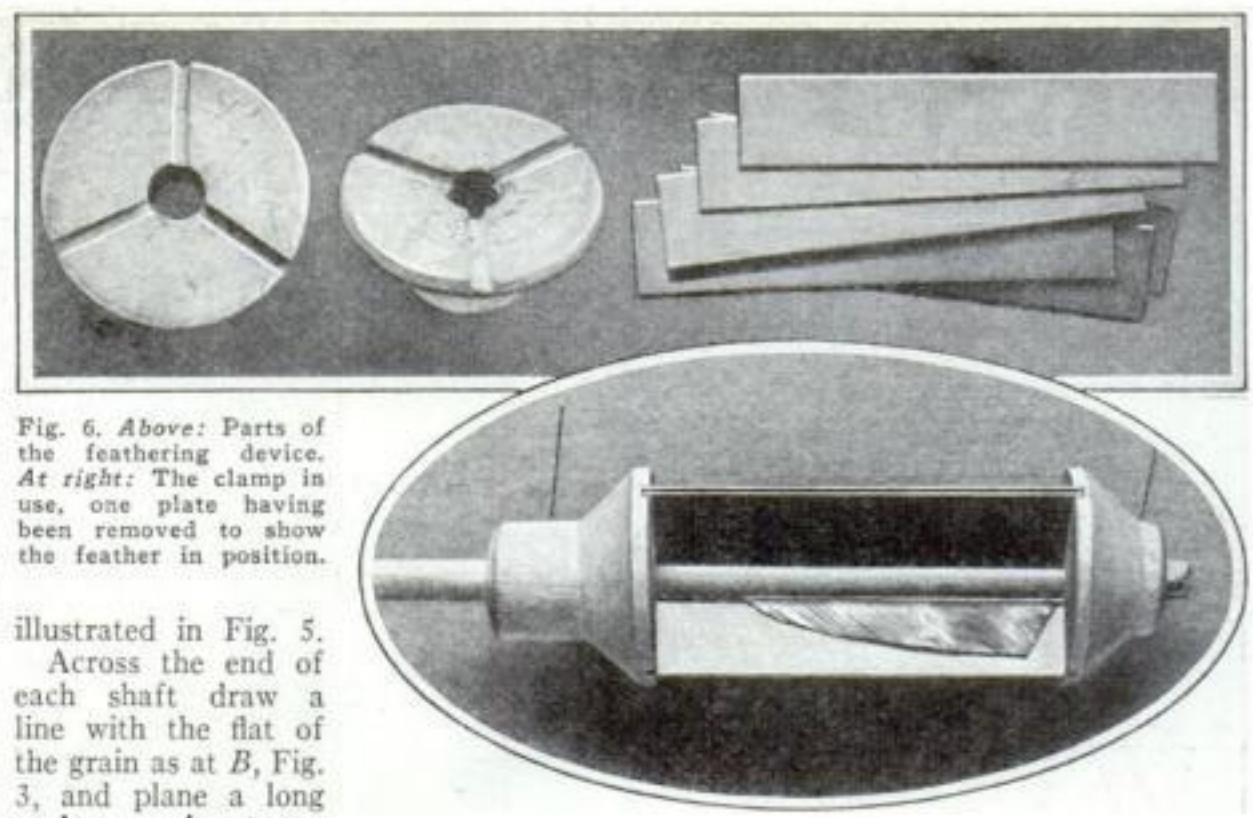


Fig. 6. *Above:* Parts of the feathering device. *At right:* The clamp in use, one plate having been removed to show the feather in position.

illustrated in Fig. 5.

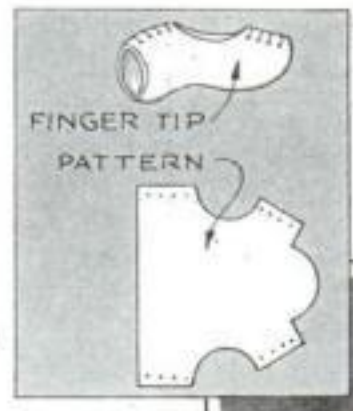
Across the end of each shaft draw a line with the flat of the grain as at *B*, Fig. 3, and plane a long wedge, coming to an edge equal in thickness to the width of the cut made by the saw which you will later use to slot the footings.

The footings should be ⅜ in. square and 7⅜ in. long. Saw down the exact center for 5⅛ in. as at *C*. Apply a high-grade waterproof cement or glue on both shaft and crotch, and insert the wedge into the footing as at *D*. After sighting to see that the footing is in a straight line with the shaft, wrap the joint with cord and set aside to dry, after which the footing is rounded as at *E*.

Many archers make it a practice to glue the footing to the shaft while the latter is still square, and afterwards round both of them at the one operation. You may follow this method if you prefer.

In fitting the metal points with knife and file, see that the wood goes clear to the end inside. Cement the points on securely.

Cut the other end of the shafts, which are customarily made in sets of six at a time, to give a length of 28 in. Note the weight of the lightest shaft and bring the others down to within five grains or less of that weight by sandpapering and slightly tapering the end which is to be feathered. The weight should be between 360 and 400 grains, the former being satisfactory for a bow which pulls or "weighs" from 35 to 40 lb.



The time-honored way of reënforcing the nock for the string is to insert a wedge-shaped piece of horn, fiber, or other hard material as shown at *A*, Fig. 3, but a more recently developed method is to use ready-made aluminum nocks which are fitted to the shaft just like the points. A still simpler method is as follows: First cut the nock for the string about ⅛ in. wide with three hack saw blades bound together. Make the cut *at right angles* to the direction of the grain as indicated at *F*, and cut it ¼ in. deep. Finish rounding the bottom of it with a file. Then, immediately above the nock, file a shallow ⅛ in. wide ring, and wrap this with silk, tying the ends under and gluing them.

Fletching is best done with the wing feathers of the turkey. Feathers from the right wing curve in the opposite direction from the left-wing feathers; it is therefore essential not to use both types on one arrow.

The fringe from the outer edge of the feather must be removed. The quickest way to do this is to hold the feather in the left hand near the top and pull sharply outward and downward to peel off the fringe (*A*, Fig. 4). Another method is to split the quill and cut off the vane with a very sharp knife. If the feathers prove difficult to handle at any stage of the fletching process, they can be softened by placing them for a short time between two damp cloths.

Next cut the feather proper into 2½-in. lengths, first clipping off and discarding a little of the thin end. Do not use these three pieces on one arrow, but rather the same relative cutting (that is, first, second, or third) from three different feathers taken from the same wing.

Hold one of the feathers between two pieces of sheet brass hinged together with a piece of tin as at *C*, Fig. 4, or in a clamp made by adding extra sheet metal jaws to a heavy paper clip as at *D*. Slice off the protruding rib along the edge of the brass. Then use a file (or a sharp knife, if you prefer) to reduce the

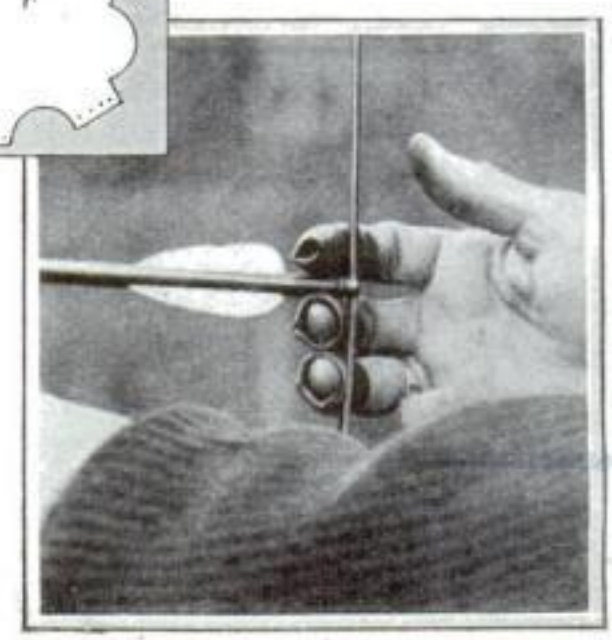


Fig. 7. How the arrow and bowstring are held, and one way to make the leather finger tips.

thickness of the rib to 1/16 in. or less. Since the flat surface you obtain in this way is to be glued to the shaft, it must be at right angles to the feather.

There are innumerable ways of attaching the feathers to the shaft. Experts often prefer to use cabinetmakers' hot glue, which sets very quickly, and merely press the feathers in place with their fingers or a large spring paper clip—or the clamp used in trimming the ribs of the feathers. Another simple method is to use two pins for each feather as shown in Fig. 2. After the pin at one end has been inserted, the other pin is used as a sort of lever to draw the feather tight.

MY OWN preference is to use a simple clamp (Fig. 6) which I designed to simplify the fletching process. With it the beginner can equal the best factory-made arrow. Cut off the ends of a large spool having the usual 11/32-in. bore. With your three hack saw blades, sink ⅛ in. square grooves as shown into the flanged ends of the spool. These should be radial grooves spaced 120° apart.

The spool ends are slipped over the arrow and held in place with pins, which pass through holes drilled for the purpose. One groove of each must be at right angles to the nock (*B*, Fig. 4). This is because one of the three feathers on an arrow (usually a feather of contrasting color or a dyed feather) is set so as to be at right angles to the bow string; the other two feathers then slip more easily past the bow when the arrow is shot. The spool ends are kept at such a distance apart that six pieces of thin, stiff brass, ½ by 3 in., can be slipped into the slots as shown in Fig. 6. A strip of paper around the shaft will make the spool ends fit tight.

TRIM one of the prepared feathers approximately to shape and place it between two of the brass slides. Smear waterproof cement or glue on both the flat rib of the feather and the shaft; then run the slides down a pair of grooves so that the large end of the feather is 1¼ in. from the end of the shaft. When the three feathers are in place, wrap a rubber band around the slides and set aside to dry. Ambroid and celluloid types of cement will dry in half an hour; other glues usually take overnight. When dry, pull off the spool ends and smooth up. Use a template to aid in trimming the feathers accurately. The two shapes generally used are shown at *B*, Fig. 4.

Use varnish or clear lacquer on the arrow to within about 5 in. of the nock. The remainder you can ornament with colored lacquer, enamel, or artist's oil colors in any way desired. Whatever arrangement of colors and bands you choose will serve to identify your own arrows. Remember that bright yellow assists materially in finding arrows.

You will require an arm guard to protect against string-slaps. This is a sheet of tough, smooth-faced leather cut to shape and laced or strapped around the forearm, but it must not bind the wrist or elbow. One type of arm guard was illustrated last month (P. S. M., July '31, p. 86). A leather riding cuff or butcher's cuff makes an excellent guard.

Make finger tips of similar material,

tight enough so that they will not slip off easily (see Fig. 7), or use a shooting glove if you prefer.

A serviceable quiver can be made of a piece of canvas 8½ in. wide by 18 in. long. Sew up the side and close the bottom with a round block of wood. The top and center should be finished with a strip of leather, and there should be a strap for fastening it to the belt. A block of lead in the bottom will keep the arrows in an upright position.

If you do not mind working hard every evening for a week, you can make a straw target for about $2.50 that will equal the factory product. Until recently, standard 4-ft. targets sold for as high as $18, but now that archery has become so popular, it is possible to obtain regulation rye straw targets for as little as $8 from the large mail order houses. If you wish to make your own, obtain the bulletin mentioned at the end of this article.

For target facings, oilcloth used dull side out is cheap and will last half a season's shooting. Sign writer's muslin, of course, is better. A curved upholstering needle will help in sewing on the facing.

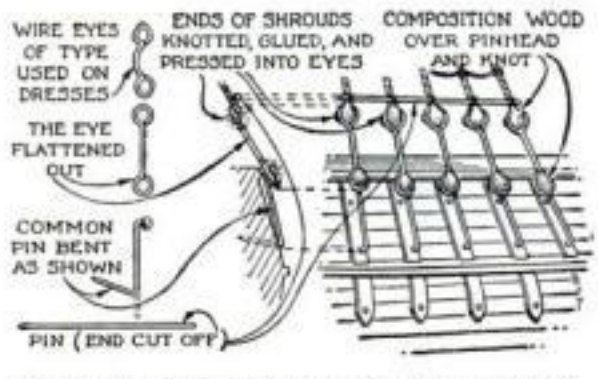
The diameter of the center ring is 9.6 in.; and the four concentric rings are each 4.8 in. wide. The center is gold, followed by red, light blue, black, and white. Hits score as follows: gold, 9; red, 7; blue, 5; black, 3; and white, 1.

Mr. Pratt has prepared some suggestions on how to shoot with the bow and arrow, as well as directions for making a straw target. These are contained in Home Workshop Bulletin No. 7, which will be sent to any reader who incloses a large (No. 10) envelope bearing his own address and a two-cent stamp. A list of dealers in archery supplies and books on the subject also will be included upon request.

EASILY MADE DEADEYES FOR SMALL MODELS

WHILE building a clipper ship model 18 in. long over all, I came to the conclusion that deadeyes small enough for the model would be too costly and would take too much time to rig, so I hit upon an inexpensive substitute—wire eyes of the type sold for use with hooks on women's dresses.

The eyes were flattened out and applied as shown. After a prepared wood paste had been pressed into all crevices and the whole had been painted black, the imitation deadeyes were quite realistic and probably neater than genuine deadeyes would have been for a model of such small size.—WARREN F. ROBINSON.



Realistic deadeyes and chain plate rigging can be made from pins and dress fasteners.

Mixing a Substitute for Plant Pills

NUTRITIVE pills which have a miraculously stimulating effect upon plant growth have been developed experimentally in recent years (P. S. M., Oct. '29, p. 29, July '30, p. 26, and Jan. '31, p. 56), but they have not yet reached the market in a commercial form. The home workshop chemist, however, can easily prepare a nutritive solution which has some of the reported characteristics of the plant pills.

Such a solution is particularly useful for potted plants, which so quickly exhaust the fertility of the soil that it is necessary, as all gardeners know, to repot the plants at intervals with fresh soil. This tedious process may be postponed by feeding the plants with the salts necessary for their growth.

To prepare the solution, add to 1 gal. of water a lump of calcium nitrate about

The greater size of the carnation plant at the right is due to the nutritive solution.

the size of a bean. Then add potassium nitrate, magnesium sulphate, potassium phosphate, and ferric chloride, each about the size of a split pea—that is, from one third to one fourth as much of each as of the calcium nitrate. This solution is highly dilute and will be of great benefit to even the most delicate plants. Apply it once or twice a week, just as if watering the plants.

The solution should not be made stronger than suggested because the results might destroy the fine root hairs and so kill the plants. Used in a weak solution, the salts are easily absorbed by the plant and utilized by it in the manufacture of its tissues.

Since the solution is a complete food, it can be used for growing almost any kind of plant without soil. Placed in the solution alone, cuttings will quickly form roots. Naturally, the plants should not be left too long, for an excess of water is just as injurious as too little. For experimental purposes, plants may be left in the nutritive solution for a few weeks.

WOODEN and cardboard labels for garden plants, fruit trees, bushes, or climbing roses soon become illegible unless specially treated. It is better to use small strips of zinc, which will last for many years. Ordinary ink, however, will not do for writing the labels. Paint is better, but as a rule must be renewed annually. A black ink that is quite lasting on zinc consists of a mixture of 1 part of copper sulphate, 1 part of potassium chlorate,

A definite program for getting ahead financially will be found on page four of this issue.

and 36 parts of water. When the ink has dried on the zinc, rub the label with a rag moistened in oil.

Another way of making a permanent zinc label is to write or print the desired characters on the zinc with a pencil and then slightly indent the letters with the point of a punch, using gentle blows of the hammer.

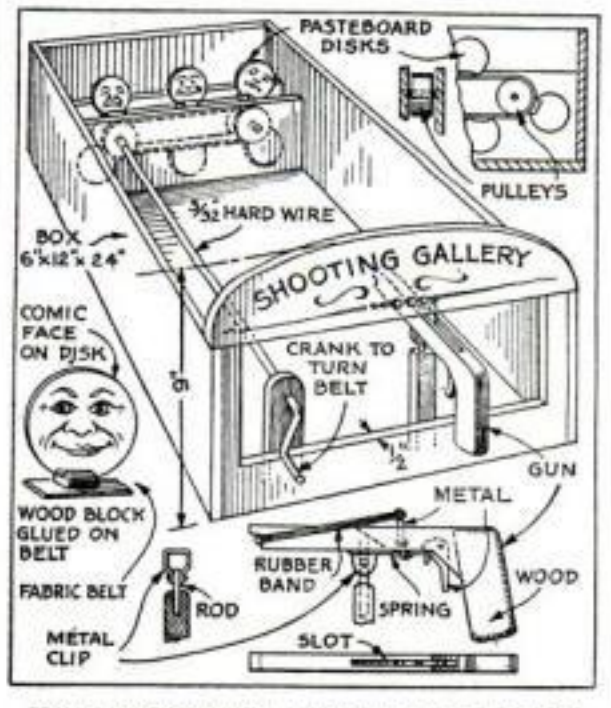
On pruning the thicker branches of bushes and trees, the wound must be covered with a substance which will prevent the entrance of fungus diseases. This can be accomplished readily by painting the cut ends with shellac.—H. BADE.

TOY SHOOTING GALLERY HAS MOVING TARGETS

In this toy gallery, rubber-band ammunition is used in shooting at the moving targets.

FUNNY faces cut from newspaper comic strips form the moving targets of this novel and amusing toy shooting gallery. The faces are pasted on cardboard disks which are mounted on an endless fabric belt turned by means of a crank.

The shooting is done with a simply made wooden pistol 6 in. long which uses rubber bands for ammunition. The fact that the pistol is mounted on a universal joint allows it to be aimed accurately. The crank can be turned with the left hand at any desired speed by the child who is doing the shooting; or, to make it more interesting, the targets can be operated by an onlooker or some boy who acts the part of gallery attendant.—D. W. C.



How the gallery is constructed, and details of targets, pulleys, and 6 in. long pistol.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

How to Construct Woodsy Fittings That Add Charm to a Log Cabin

By

WILLIAM G. DORR, A.I.A.

This cabin, like that shown in our Blueprint No. 134, has batten window shutters, and the porch shutters are divided horizontally, hinged top and bottom, and bolted in the middle.

IN ANY well-designed and carefully constructed log cabin such as that described last month (P. S. M., July '31, p. 92) and shown in POPULAR SCIENCE MONTHLY Blueprint No. 134 (see page 91), there are certain features that add materially to the charm of its appearance.

A covered terrace at the front entrance and a sheltered kitchen door, which may be simply an extension of the roof on brackets, are especially desirable, as are window and porch shutters that enable one to close and open up the cabin quickly. If porch shutters are divided horizontally as shown on Blueprint No. 134, the upper half may be allowed to rest upon two birch poles to form a quaint awning; and the lower half, when necessary, may be fastened up for protection against storms or for greater privacy at night.

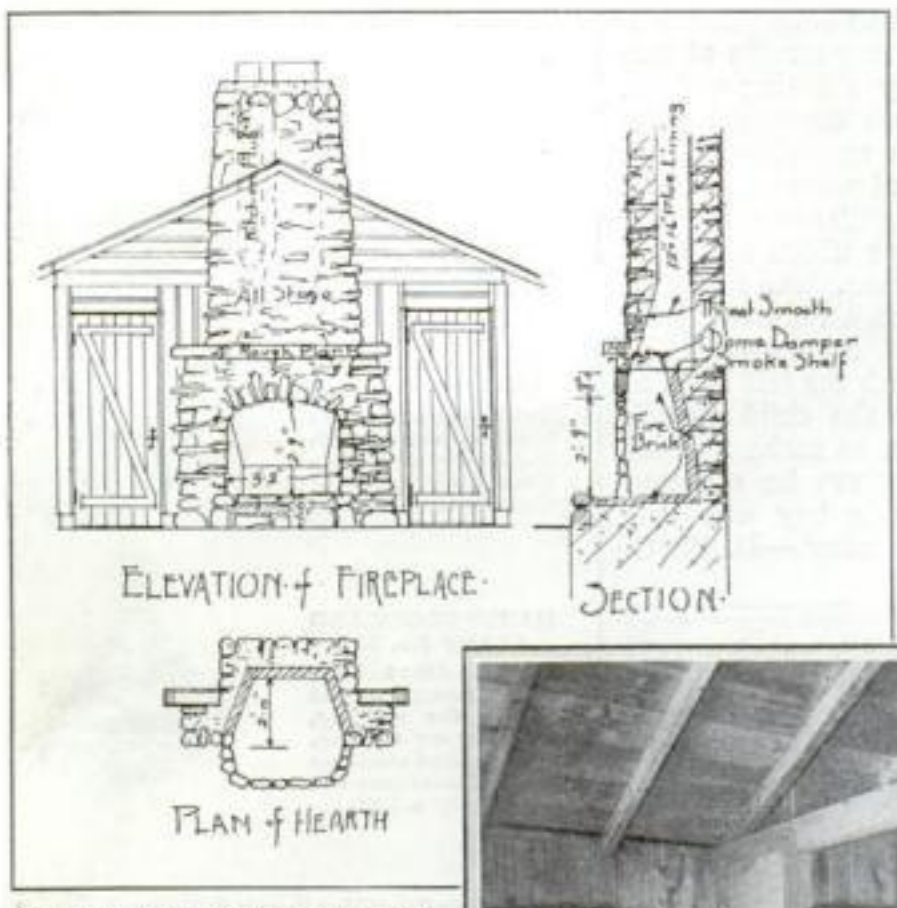
Make all the doors on the job as detailed in the blueprint with the exception of screen doors, which may be ordered along with the casement sash and the window screens from the mill. The casements are designed to swing in. Door and window frames are made of dressed plank, and the sills are pitched to drain out.

Outer doors may be constructed like the inside doors—two thicknesses of dressed and matched lumber with Z-batten strips; or they may be made of three thicknesses, both sides vertical over a horizontal core of boards. Cupboards and bookshelves—in fact, all so-called "millwork" — should be made by hand. These had better be a bit crude looking than out of harmony with the rustic surroundings.

The fireplace is the heart of your forest home. One of rough-faced rock is always preferable to any other, but brick or concrete may be used. Uninteresting field stones may be made colorful by rough-facing them with a spalling hammer.

If the masonry is heavy enough, a flue lining is not necessary, but it is a distinct help to the inexperienced mason. A 6-in. cement cap tops the chimney, and the flue lining projects from 6 to 8 in. to aid the draw. Fire bricks laid in cement mortar (1 part cement to 1 of sand) line the fire chamber and hearth.

Several kinds of wall finish are possible if you have used the frame construction and do not wish the studs to show. The easiest to apply is some sort of wall board or insulating board. Slightly higher in cost and labor is a wall lining of pine boards, with or without batten strips. The preferred construction is to apply an insulation board to the studding—or cut flexible insulating quilts in between the studs—and then apply either the new type of knotty pine log siding described last month (provided, of course, that it has also been used for the exterior) or wide pine boards set vertically with batten strips covering the joints. The living room might have the preferred finish and the bedroom and kitchen the cheaper finish, or the latter may be left unfinished if the cabin is not to be used in cold weather.



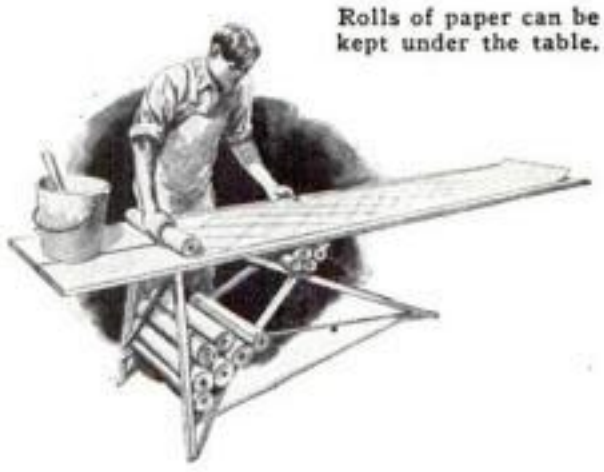
The fireplace should have an adequate smoke chamber, a damper well above the opening, and a smooth throat. A raised opening throws the heat more directly into the room. The chimney shelf may be of rock or a heavy timber. If real log construction is used, the logs are built into the masonry. Lugs for a crane, if desired, must be set into the fire bricks when they are being laid.

Simple furnishings made by one's own ingenuity and handicraft are by far the most effective. Avoid "city furniture" like the plague.

This is the second of two articles on log cabins by Mr. Dorr, who wishes to acknowledge the courtesy of Chilson D. Aldrich, author of "The Real Log Cabin," in providing all the suggestions and details relating to the use of genuine log construction.

WALL PAPERING TABLE SET UP ON FOLDING IRONING BOARD

THOSE who undertake wall papering at home rarely can find a suitable place to spread the paper and apply the paste. Neither the kitchen table nor the hall floor is a satisfactory substitute for a paper hanger's bench. What does serve the purpose very well, however, is a common folding ironing board upon which is laid a top of any convenient length made by fasten-



Rolls of paper can be kept under the table.

ing two 1 by 10 in. boards together with battens underneath.

A table of this type is easily moved from room to room and it has a further great advantage in that the construction of the ironing board framework affords ample foot room while working around it. The angles formed by the ironing board braces provide convenient places to keep the rolls of paper: those for the wall can be placed in the large lower angle, and the border or ceiling rolls in the smaller crotch above.—Lyne Loving.

USES ENLARGING OUTFIT AS COPYING CAMERA

PHOTOGRAPHS can be copied without difficulty even with a small and inexpensive camera if a simple homemade enlarging outfit is available similar to that recently described in an article by Everett Eames (P.S.M., Mar. '31, p. 96). One of these enlarging machines was constructed by Ronald G. Sechler, of Norristown, Pa., who found that it worked even better than he had hoped. With his No. 1 folding camera, he is able to enlarge from 2¼ by 3¼ to 10 by 12 with excellent results.

Mr. Sechler quickly discovered that he could also copy any photograph by placing it face down between two sheets of glass and setting the glass on two blocks of wood about 2 in. high in the light box of the enlarging outfit. Because of the heat, the lights cannot be kept on more than a minute or two at a time while focusing. When everything is ready, the film is placed on the enlarging board and the lights are flashed on to make the exposure. In this process the enlarging camera acts as a reflectoscope.

Any small objects which will lie flat on the glass in the light box also can be photographed in the same way. Once the negative has been obtained, enlargements of any size can be made in the usual way with the same enlarging device.

A Desk of Modern Design

Easy as it is to construct, this desk has the characteristics of the finest and costliest modern furniture.

Tired of building ordinary furniture? Then consider this distinctive desk, which is in the latest mode yet not too extreme. The piece was designed and built by W. E. Mitchell, who is president of an automobile financing company in Spokane, Wash. His hobby is cabinetmaking.

THE desk illustrated is of present-day or what is now often spoken of as "contemporary" design, but the general lines are not strictly modernistic and there is nothing harsh or clashing about them. Indeed, straight lines, if designed in harmony and simplicity, are as restful and beautiful as curves.

The construction involves no difficult cabinetmaking. The stock for the principal exposed surfaces is ⅝ in. thick five-ply birch, which can be purchased in sizes that cut with little waste. While solid wood could be used, plywood is strong and much lighter in weight because it can be used a good deal thinner than ordinary boards; it is also easier to use.

If the desk is built of plywood, a framework should be constructed of 1½ or 2 in. wide stock for the top and 1¼ in. wide stock for the remainder. The top frame should be braced with crosspieces placed 16 in. from each end and mortised to the front and back pieces. In preparing the framework, it is necessary to allow for the ⅝ in. thick plywood facing.

Additional strength is given the framework by the drawer rails, as the rail for the drawer in each end of the desk can be placed along the back to reënforce it, and the rails for the front drawers strengthen the ends.

After the framework has been built, the front and ends should be prepared. The spacing of the drawer openings depends partly upon the frame construction and partly upon individual tastes and requirements; however, the sizes of the openings in the original desk are given on the drawing as an approximate guide. The back is plain except for two ornamental openings cut as shown.

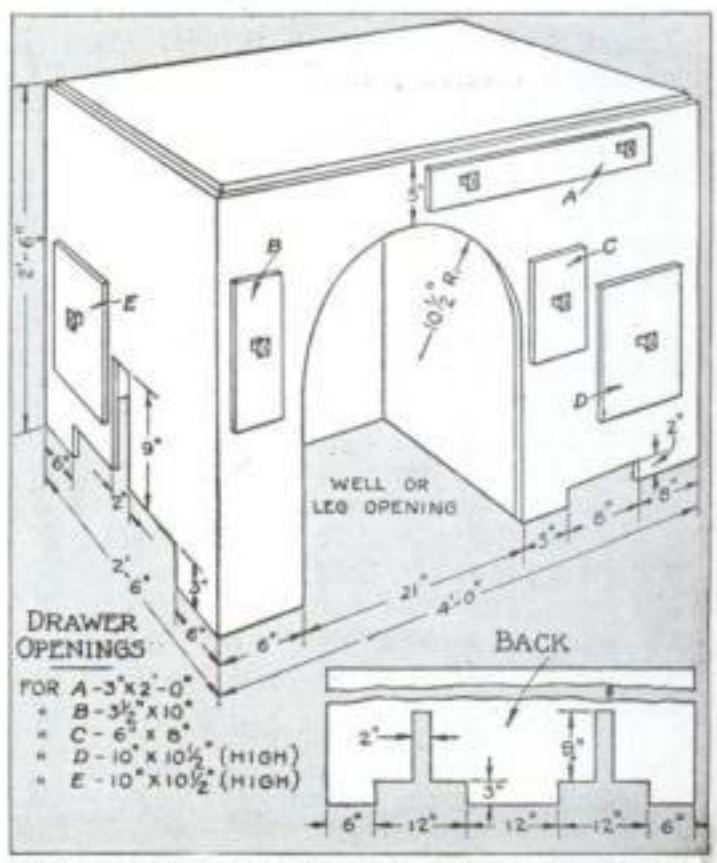
The plywood is glued and screwed to the framework, and all screws are countersunk and concealed with any high-grade composition sold for such purposes. The holes are slightly overfilled and afterwards sandpapered to an even surface in order to avoid sunken spots when the finish is applied.

The drawers are made in the usual manner. The fronts overlap the openings by ¼ in. all around, and their edges are rounded. In the desk illustrated the drawer fronts were made of 1-in. solid birch and were rabbeted to receive the sidepieces.

The well or leg opening is lined on both sides and at the back with ⅜-in. plywood.

Too much stress cannot be laid on the preparation of the surface of the wood for finishing. Sandpaper it thoroughly with a fine-grain paper. While the finish may be in any color to suit the maker, it should be in keeping with the design—that is, modern. The original desk was given a coat of filler, two coats of flat black wall paint, and three coats of black enamel, sanded after each coat with No. 4/0 garnet paper. The last coat was clear varnish, which was rubbed with pumice stone and oil.

The antique brass drawer pulls are square in design. High-grade gliding casters under each corner allow the desk to be moved easily.—W. E. Mitchell.



The general design of the desk with the principal dimensions, which, of course, may be modified as desired.

BOX OF HOT SAND KEEPS CHROMIUM PLATING SOLUTION WARM

THE problem of maintaining the correct temperature in chromium plating baths is easily solved by the convenient arrangement illustrated. Operating on the principle of the fireless cooker, this device eliminates the necessity of working in a hot room and removes the chances of obtaining a worthless, milky deposit because of the chilling of the solution.

The jacket, which can be made from an ordinary soap box, should be lined with

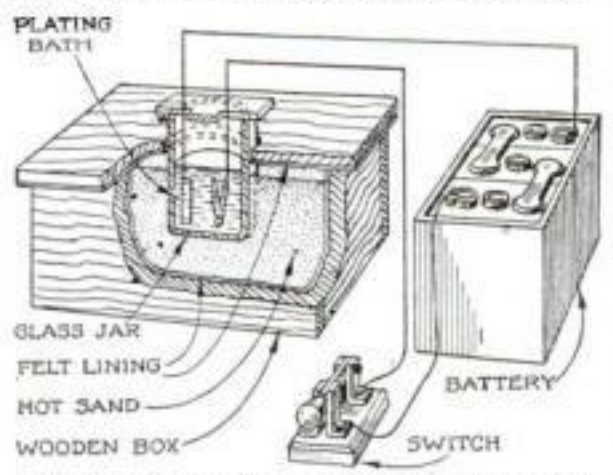
A felt lined box holds the sand.

a suitable insulating material. The writer has found that building felt serves satisfactorily. Provide the box with a close-fitting lid and line this also. Cut a hole in the lid large enough to receive the bath container, making the hole a trifle larger than the vessel.

Building sand is used as the heating element. Roast a quantity of this over a flame to a temperature of 160°. In the meantime, heat the bath by immersing the plating jar with the solution in it in cold water and heating the water until it boils. Because of this heating, it is well to use an unbreakable glass container as the plating bath vessel.

Pour a layer of the hot sand into the box, set the bath in place, and then fill the box with sand up to the level of the top of the plating solution.

Sand retains heat for a long time, and by using this method a constant temperature well above 120° can be maintained for two hours.—ALEXANDER MAXWELL.



Diagrammatic sketch with broken out portion to show the construction of the sand box.

A Hinged Trellis Saves Work

By

JOHN M. CHITTENDEN

TRELLISES improve the appearance of any home, but if they are attached directly to a house it requires a great deal of work to take down the vines when the building has to be repainted. By setting up trellises as shown in the accompanying drawings, this difficulty may be avoided. The trellises are swung away from the house as in Fig. 1 on hinges that are embedded in small concrete blocks.

Figure 2 at *A* shows the form used in casting the concrete bases. It is made entirely of ¾-in. stock 8 in. wide and is held together by means of ⅜ by 8 in. carriage bolts. Being made in this way, it can be used over and over again.

After the form has been set up, it should be thoroughly greased inside to prevent the concrete from adhering to the wood and to insure smooth castings. As soon as the concrete has been poured, one end of a 4-in. strap hinge (with nails run through the screw holes to act as tie-rods as shown at *B*) is embedded in the mixture. Give the concrete sufficient time to harden before removing the form.

The method of erecting the trellises is illustrated at *B*. The base of the trellis is fastened with brass screws to the hinge

Fig. 1. When the house is being painted, the trellis and vine can be swung out of the way.

or hinges, if two or more blocks are required for the trellis. Iron screws should be avoided because they rust and ulti-

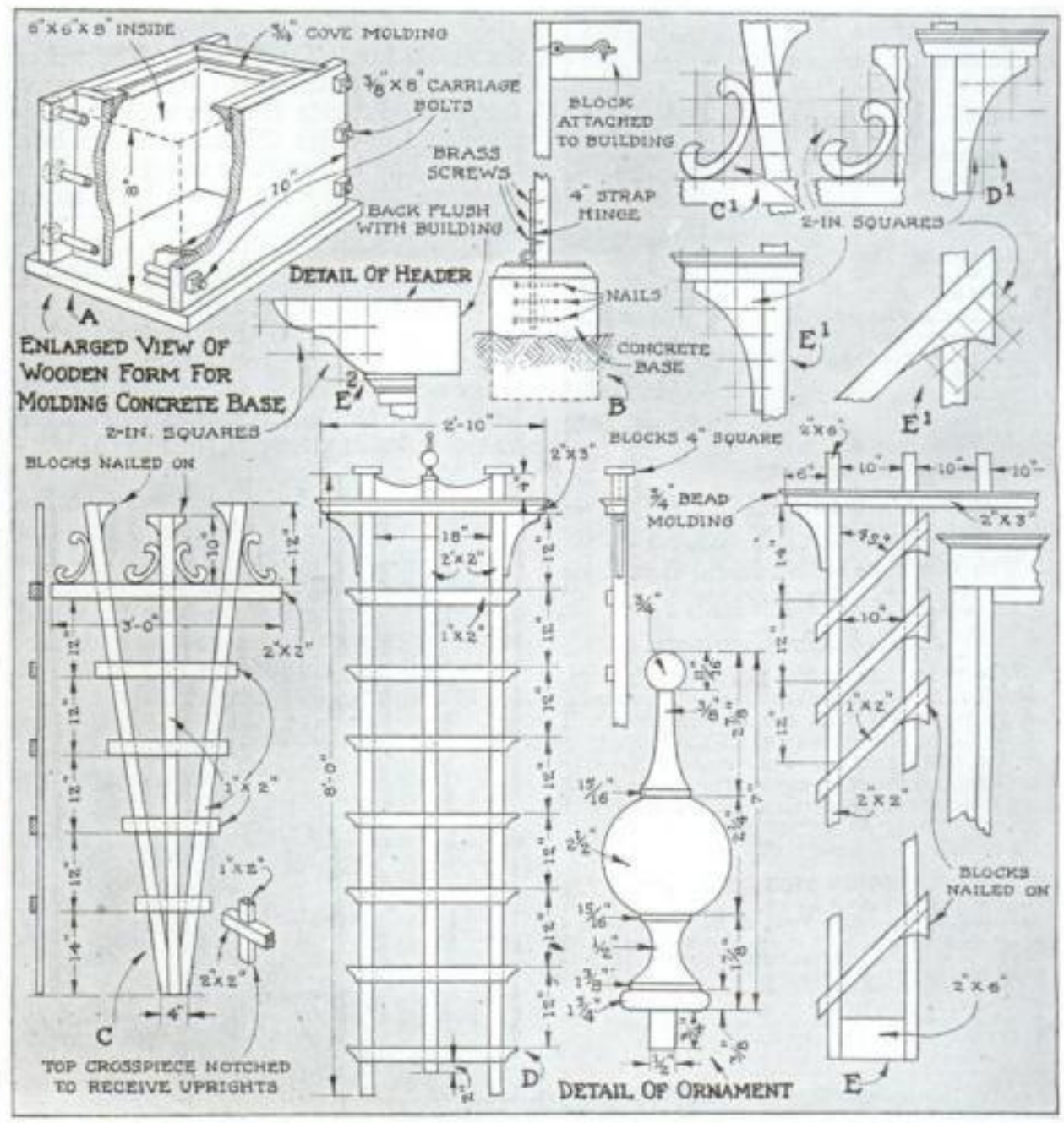


Fig. 2. Drawings showing the construction of the form for molding the concrete bases, the manner of erecting the trellises, and suggestions on the construction of three trellises.

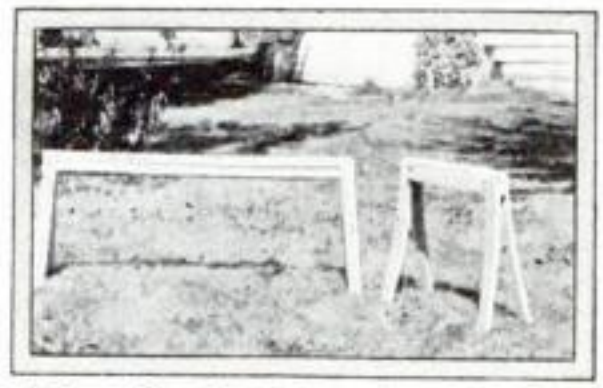
A definite program for getting ahead financially will be found on page four of this issue.

mately cause the wood to rot. Wooden brackets or blocks are attached to the building in such positions that the top of the trellis can be fastened by means of hooks and eyes, preferably of brass.

Suggestions for three ornamental trellises adaptable to this method of construction are given at *C*, *D*, and *E* in Fig. 2 with corresponding details at C^1, D^1, and E^1. The first and second are flat trellises and the third an arbor trellis that goes around a window. Necessarily, the dimensions of the latter will have to be altered to suit the window.

The painting of trellises is a tedious job, but if done properly it will not have to be repeated for several years. It pays to apply a priming coat of aluminum paint, which prevents checking and weathering and gives the two finishing coats a much longer life.

ADJUSTABLE TRESTLES FOR THE HOME SHOP



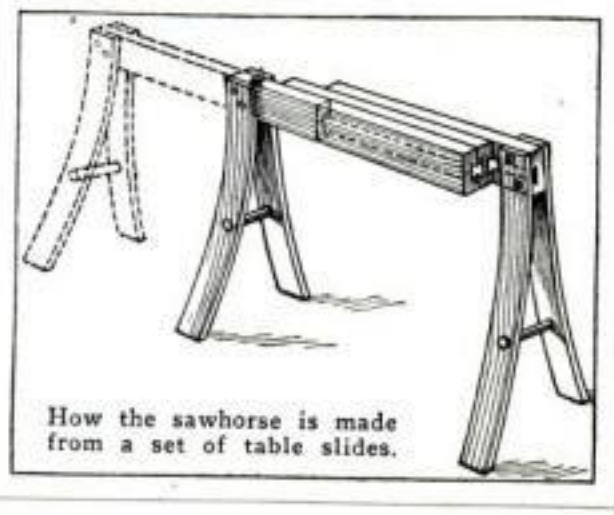
Being adjustable in length, sawhorses or trestles like these have innumerable uses.

HAVE you ever wished for a trestle or sawhorse that was adjustable as to length? Well, here it is, and it can be constructed from a set of slides taken from a discarded extension top dining table, four oak barrel staves, and two short sections of ¾-in. dowel rod.

The number of sliding sections used determines the maximum length to which the horse can be extended. In those shown in the illustration, three sections were used and the horse measured 24 in. when closed and 42 in. when opened.

Cut the barrel staves to the desired length and drill a ¾-in. hole in the center of each. These holes are for the ¾-in. dowel rod braces that are fastened between each set of legs. Assemble the legs and braces in sets and then fasten the legs in place with screws, being careful that the screws do not enter more than one of the sliding sections.

If desired, these extension sections can be purchased new from any of the larger cabinet hardware and fixture supply houses.—F. U. JUDD.



How the sawhorse is made from a set of table slides.

This Corner Chair

Combines Grace and Novelty

By HERMAN HJORTH

Fig. 1. This roundabout chair is a piece designed especially to ornament a corner.

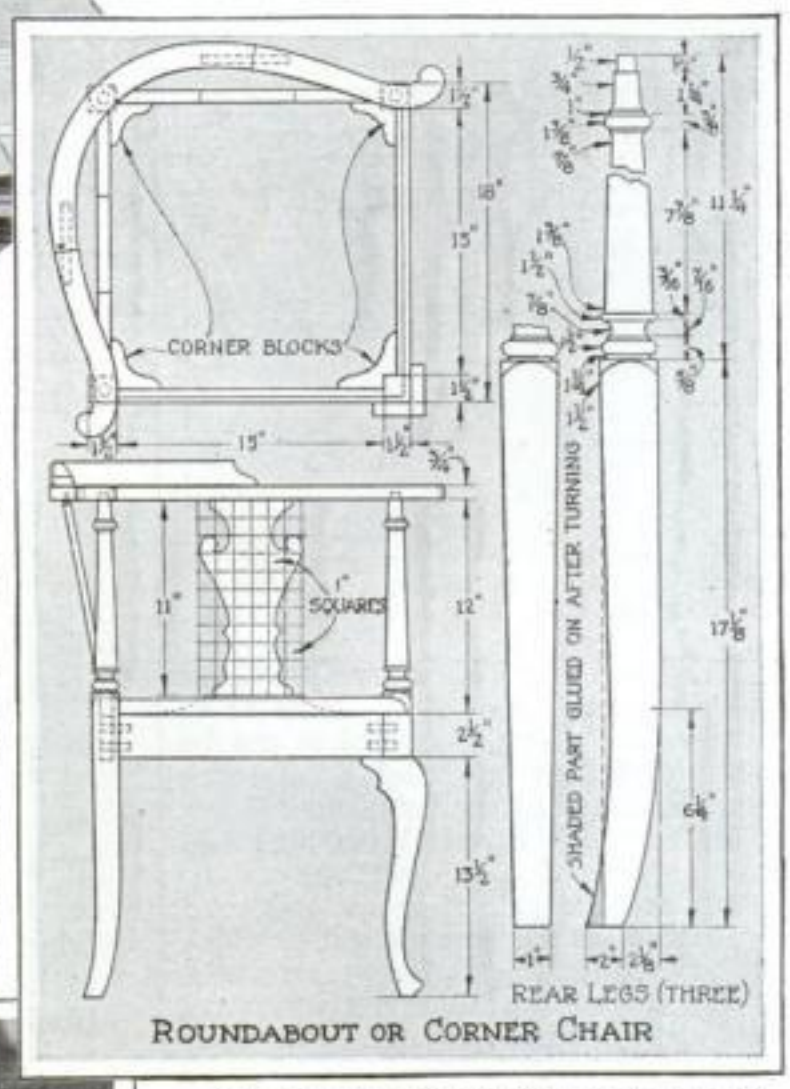


Fig. 2. Assembly views of the corner chair and drawings showing the shape of the rear legs.

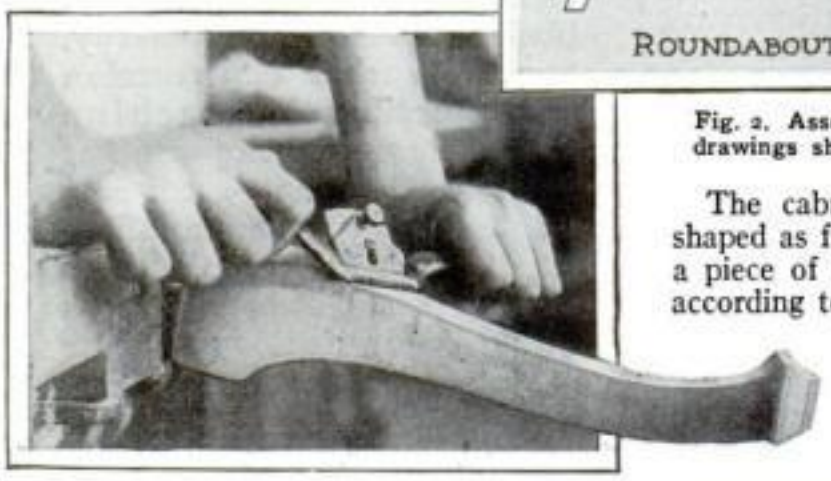


Fig. 3. Shaping the cabriole leg after it has been roughly cut to shape on a band saw.

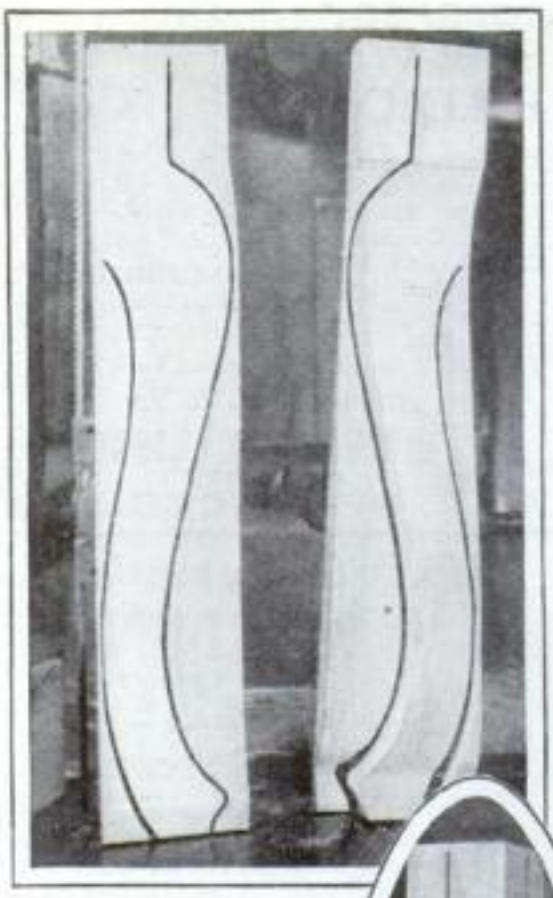


Fig. 4. In oval, one side cut, other side marked. Above, second side cut; the right piece is the leg, the left piece is waste.

IF YOU are looking for something unusual in furniture, the corner chair illustrated in Fig. 1 should prove to be an interesting project.

Its characteristic features are the square seat, which sometimes has a rounded front corner; its cabriole leg, typical of the Queen Anne and Chippendale periods; and its three turned rear legs.

While the drawing in Fig. 2 at first glance appears quite complicated, it will be found on closer inspection that the construction is easier in certain respects than that of an ordinary chair, the frame being square.

The upper parts of the rear legs are first turned as shown. A pattern is then made for the lower ends, and a block is glued to the lower rear edge of each (the shaded part on the drawing) so that the shape can be cut with a band or turning saw. Note that two of the legs are cut on a curve from one face and merely tapered from the adjacent face, but the third or rear corner leg, like the front leg, must be cut on a curve from two faces.

The cabriole leg in front is cut and shaped as follows: Draw 1-in. squares on a piece of cardboard, plot in the outline according to Fig. 6, and cut out the template. Square a piece of stock to dimensions 3 by 3 by 16 in. and mark the outline on two adjoining sides as shown in Fig. 5, making sure, however, that the sides on which the outline is marked are square to each other. Saw one of the sides on a band saw, following the outline but leaving just a little wood at the end of each cut so that the pieces are not separated (see Fig. 4). Then saw the other side, following the outline right through and separating the pieces. The sawing is now completed except for the small piece at the end of the first two saw cuts. Shape the leg with a spokeshave, file, scraper, and sandpaper as in Fig. 3. The sharp front and rear edges should be rounded off.

The front and rear rails are now made and joined to the legs with ⅜-in. dowels. A rabbet for the seat must be cut in the front rails and a corresponding recess sawed and chiseled in the upper end of the front leg. The frame is now glued together, after which the corner blocks are fitted, glued, and screwed to the rails. These blocks should be placed in position so that their upper surfaces are flush with the lower edge of the rabbet in the front rails.

The arm, as shown in detail in Fig. 6, is made in two pieces, which are doweled together. The joined pieces are then reënforced by the back, which is sawed out of a 1¾-in. plank and glued on top. The holes for the legs are now marked and bored, and the arm is fitted in place but not glued.

The splats (see Fig. 2) are made next. Use ½-in. stock and plane it to width, making it a trifle longer than is actually necessary. Lay out all the angles with a steel square placed on the edge of the stock as shown in the drawing, Fig. 6. Remember that the upper and lower cuts on the splat are at the same angle and are parallel. The easiest way of locating the dowels in this case will probably be to drive small brads into the ends of the splat, cut their heads off, and then place the splat in position. The nails will mark the location of the dowels on the rails and underside of the arms.

In shaping the splats, they may be nailed together outside the line and sawed on the band saw.

A frame is made for the seat as shown. A thin piece of plywood may be nailed to the top of this or upholsterer's webbing may be stretched over it. The seat can

A definite program for getting ahead financially will be found on page four of this issue.

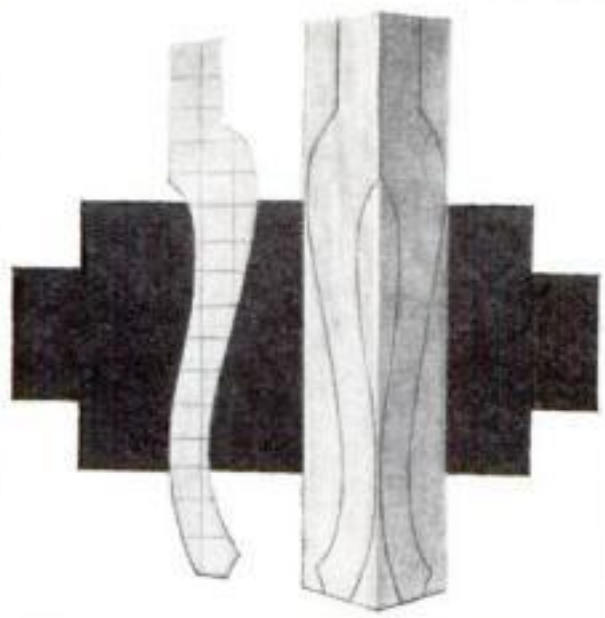


Fig. 5. The front leg template and how the square stock is marked prior to being shaped.

then be upholstered in the usual manner.

Regarding the selection of wood, a close-grained cabinet wood is the most suitable, although the seat frame can be made of a cheaper soft wood.

Directions for wood finishing will be found in many past issues (P. S. M., Apr. '30, p. 76; Feb. '30, p. 88; and Jan. '30, p. 80).

Bill of Materials

No. of pieces	Description	T.	W.	L.
3	Rear legs	1½	1½	28½
1	Front leg	3	3	16
2	Front rails	¾	2½	15
2	Rear rails	¾	3½	15
2	Arms	¾	4	20
1	Back for arms	1½	6	17
2	Splats	½	6	13
4	Seat frame	¾	2	16¼
4	Corner blocks	1½	2	5

All dimensions are in inches.

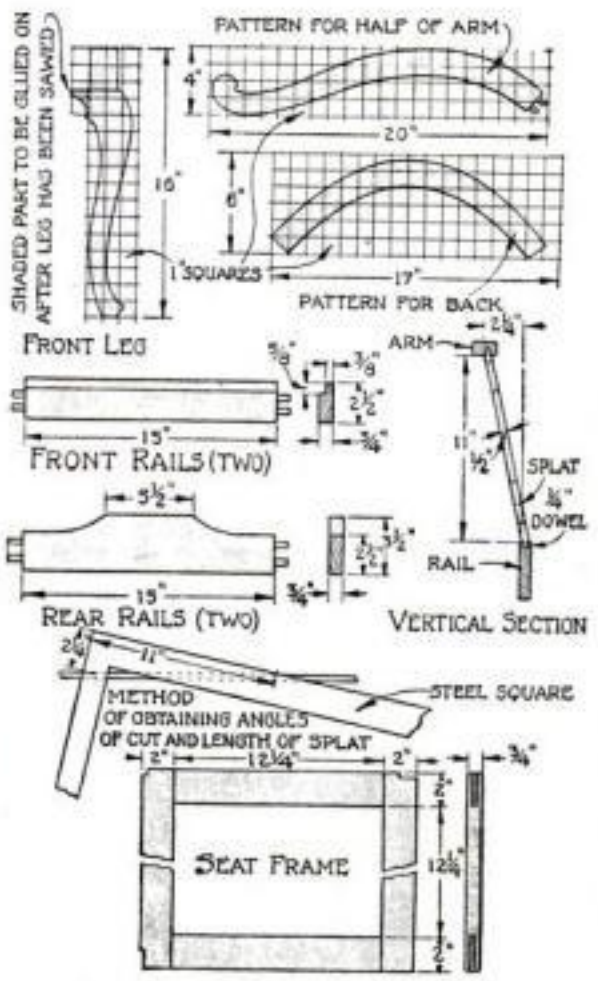


Fig. 6. Dimensions of the front leg, back, arm, and rails, and other points of construction.

A SMILING CLOWN TO HOLD YOUR TIES

WHAT boy wouldn't keep his ties in order if he had a comical clown tie rack like that illustrated? The outstretched arms and legs are hinged to the body so that they can be swung forward to make it easier to remove or replace the ties, yet the whole takes up little space on the wall. Being brightly colored and novel in design, the rack has a more decorative and playful quality than conventional holders.

The body is nailed or screwed in place but the arms and the legs swing out.

Of course, it is not necessary to confine the holder to ties. It can be used for towels, if preferred, or in some cases perhaps for both, as the swinging arms and legs can be kept well separated.

First, lay out a full size drawing of the clown's body and one arm and leg. This can be done quickly and easily by drawing 2-in. squares on a sheet of wrapping paper and copying the outline as it appears in the accompanying diagram.

Select a straight-grained softwood board ¼ in. thick and large enough to lay out all five parts, and plane and sandpaper the surfaces as smooth as possible. With typewriter carbon paper, transfer the outlines to the wood, taking care that the grain of the wood runs up and down the body of the clown and the long way of the arms and legs.

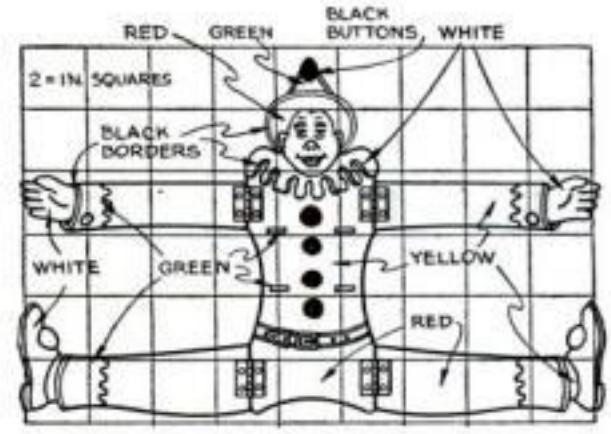
Cut the parts out with a fret saw or a fine-toothed keyhole saw. Fit them in their correct positions on top of your bench and assemble them with four ¾ by 1 in. brass hinges and ¼-in. No. 2 flathead screws or, better still, rivets.

Apply a coat of shellac or size to both sides. When it dries, rub the surface to an extra smooth finish with very fine sandpaper. You are now ready to apply the enamel. To save the expense of buying several tins of enamel, obtain one small tin of white enamel and a few tubes of artists' oil color (or a cheap box of the tube paints) and use the oil paints to tint small amounts of the white enamel to the desired colors. A drop or two of turpentine will thin the colors a little if necessary.

Either follow the color scheme suggested on the drawing or invent one of your own. Paint right over the hinges. After the colors are dry, use black for the necessary outlining and for the lower edge of the collar and the pompons and buttons.

Attach the holder to the wall with one or two screws driven through the buttons and countersink the heads, afterwards touching them up with the black enamel.

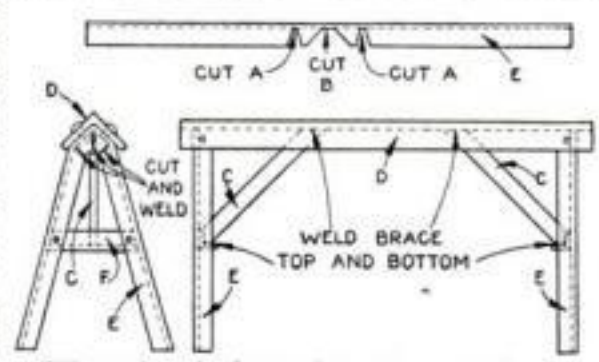
If it is desired to have the holder stand off from the wall or other surface, blocks should be placed between the holder and wall and the screws driven through them into the wall.—G. A. CRITTENDEN.



Using the 2-in. squares as a guide, make a full size pattern for cutting out the clown.

DURABLE STEEL HORSES FOR SHOP USE

SINCE oxy-acetylene cutting and welding torches have come into everyday use in shop and factory, it is no longer entirely safe or satisfactory to have sawbucks or sawhorses made of wood. The substitution of steel for wood is advantageous in every way. The horses last indefinitely; they are much stronger; and in proportion to their strength, they are lighter and easier to handle and transport.



Side and end views of a strong steel sawhorse, and one of the legs as cut for bending.

The type of horse in use in one shop is shown in the accompanying drawing. The top member *D* is angle iron; the legs *E* are also angle iron of slightly lighter weight, cut for bending as shown at *A* and *B*. The cut at *B* has an included angle of 90°; the cuts at *A*, 32° each. Welds are made at *A* and *B* after the cuts are closed by bending. The bends are easily made, especially if the iron is heated with the burning torch at the point to be bent. If that is done, the legs can be bent around by hand without placing them in a vise.

The braces *F* are shorter pieces of angle iron, while the braces *C* are pieces of bar iron, cut to fit and welded fast at each end. Bolts or rivets are used for connecting *D* to *E* and *F* to *E*.—CHARLES B. DEAN.

MEGAPHONE AMPLIFIES HARMONICA MUSIC

THE volume of a harmonica can be increased for playing in public, especially in large auditoriums or outdoors, by amplifying the sound with a medium-sized megaphone.

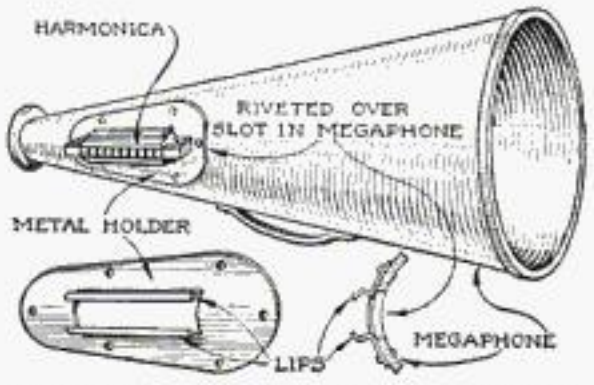
A slot is cut in the megaphone about 3 in. from the mouthpiece, and over this is riveted a metal holder made as illustrated below with two lips to grip the harmonica, which is of the "marine band" type.

When full volume is desired, the player places his left hand over the mouthpiece,

The volume is regulated with the left hand.

causing practically all the sound to pass out through the bell. A slight mute is obtained by extending the right hand over the bell.

Because greater volume is attained with less effort, this idea helps players who have experienced difficulty from lack of breath. Furthermore, the player does not have to face his audience directly, which is an advantage if he suffers from nervousness. Of course, when he carries the megaphone on the stage, he looks like a "crooner," but as soon as he starts playing —well there's a surprise in store for the audience.—ROBERT D. PIKE.



How the harmonica is attached to the megaphone by means of a holder made of metal.

DECKING A HIGH-SPEED OUTBOARD BOAT

THERE are a number of ways to cover the deck of an outboard racing boat such as the one shown on POPULAR SCIENCE MONTHLY Blueprints Nos. 128 and 129 (see page 91). One of the most original was developed by John G. McKean, of Alexandria, La., after he had visited an automobile show and seen a cut-away section of a popular make of car, the top of which had been stretched over fine gage poultry wire. He made use of this idea and tacked poultry netting over the deck of his boat before applying the canvas. This gave a smooth deck without any evidence of the ribs underneath—and

one not likely to be torn or punctured.

Other standard methods are as follows:

Plywood ⅛ or 3/16 in. thick with a battened joint down the center of the deck. Very strong, fairly light in weight; presents a smooth and beautiful appearance when varnished, but requires care to make a good job.

Planking 3/16 or ¼ in. thick used with a batten under each seam, the plank edges being nailed to the battens. Strong, fairly light; smooth and neat in appearance whether painted or varnished.

Artificial pressed wood ⅛ in. thick applied with a battened seam down the center. The finished deck can be painted or covered with cloth and treated with airplane dope, then painted or lacquered. Strong, fairly easy to apply, neat, and not injured by falling objects.

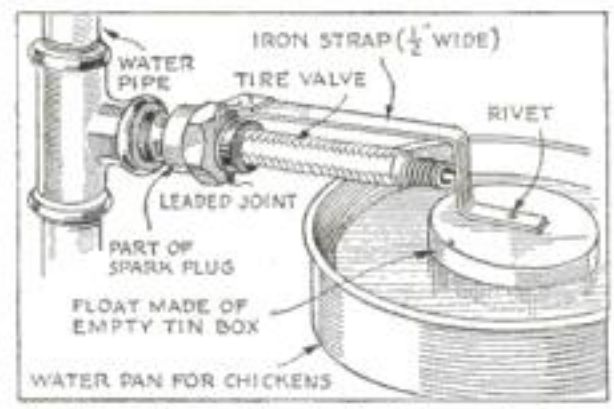
Artificial leather. Battens are notched into the deck beams so as to project ½ in. The artificial leather is stretched tightly over the deck and tacked along the sides, and the tacked edge is covered with a molding. Fairly strong, easy to apply, and neat. Can be painted, if desired.

Fabric. Battens are used as for artificial leather. A good grade of muslin is stretched over the deck and tacked along the sides. Three coats of airplane wing dope are applied. The deck then may be painted or lacquered any desired color. Fairly strong, easy to apply, very neat in appearance, but likely to be punctured if a heavy object falls upon it.—W. J.

AUTOMATIC VALVE KEEPS WATER PANS FILLED

ON A LARGE California chicken ranch, several hundred water pans are kept filled by means of the simple and inexpensive type of automatic valve illustrated.

An old automobile tire valve provides the principal part of the mechanism. It is fastened as shown to part of a discarded spark plug by means of molten lead. The float consists of an empty tin shoe polish box riveted to one end of a piece of ½ or ¾ in. wide strap iron. The other end of the strap iron is riveted to one leaf of a small hinge, and the other leaf of the hinge is soldered to the spark plug. The valve stem is screwed out about ⅛ in. and the strap iron is bent so that when the water falls below a certain level the valve will open.



A tire valve and the body of a spark plug form this convenient automatic water valve.

A similar type of valve may be used for automatically filling a vapor pan in a hot air furnace and other similar purposes.—R. J. STEPHENS.

A SIMPLE SHORT WAVE CONVERTER

(Continued from page 69)

have checked each wire against the diagrams at least three times.

After you are sure that the wiring is right and that all connections are solid, you are ready to put the converter unit into operation. First plug a type 224 screen grid tube in socket *H* and another in socket *G*. It is absolutely necessary to use high grade tubes in good condition. If you use a low grade tube or a partly exhausted one in either socket the set will not operate at all. Place a high grade type 227 tube in socket *F*. Here, too, a good one is necessary because a poor tube will not allow a sufficient flow of current and the resulting low B voltages will not operate the screen grid tubes.

The next step is to disconnect the antenna wire from your broadcast set and attach it to the binding post marked "antenna"

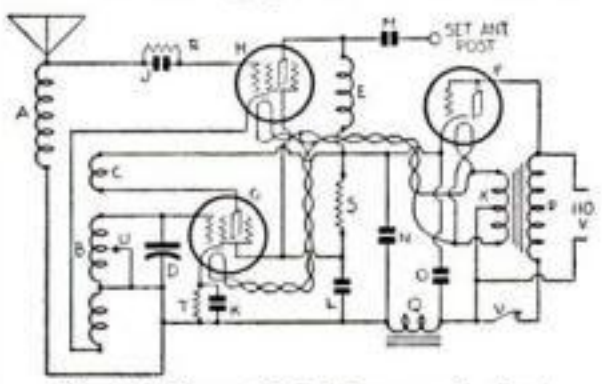


Fig. 6. Theoretical diagram of short wave set that gives idea of wiring.

on the converter unit. Then run a wire from the broadcast set antenna binding post to the binding post on the converter marked "Antenna Post on Set." Leave the ground wire connected to the ground binding post of the broadcast receiver. Do not use any ground connection on the converter unit.

Now plug the electric light cord from the converter into any convenient socket and turn on switch *V*. Also turn on the current to the broadcast set. The tubes should begin to glow. Allow them a minute to arrive at operating temperature and then slowly turn the dial on condenser *D*. A vernier dial of any good type is desirable, as the tuning is quite sharp.

As you turn the dial with switch *U* in the open position, you should hear a number of little chirping noises at various points on the dial. As the dial slowly moves each one of these chirps starts at a very high pitch which becomes lower and lower and then starts to go up and out again. Wherever you hear such a noise a station is coming in, and if you turn the dial carefully and slowly enough, you will be able to find a spot right in the middle of the chirp where the whistle disappears and a station will be heard.

If you do not hear any chirps or whistles it is proof that the tube in socket *G* is not oscillating, either because it is a poor tube, because there is some wrong connection, or because the coil *C* is connected the wrong way. First try interchanging the tubes in sockets *H* and *G*, and if this does not produce results reverse the connections to coil *C*. Also try reversing the plug in the light socket.

You should be able to hear signals with a modern screen grid broadcast receiver no matter where the single dial of the broadcast outfit is placed. You will find it necessary to try several settings for the broadcast receiver dial to locate the point where there is the least possible interference.

When switch *U* is to the open position, all of the turns on coil *B* are in use and the converter will tune from 60 to 125 meters. When switch *U* is in the closed position, a portion of coil *B* is short-circuited and thus put out of commission. The receiver then tunes the waves from 20 to 65.

HOW TO SPOT IGNITION TROUBLE

(Continued from page 70)

"What kind of a new-fangled trouble is that?" Colonel Marrold asked.

"Just what you said a moment ago," Gus replied. "It's like soldiers out of step. In nearly all of these eight-cylinder jobs, the timer is made so that one set of contact points fires half the cylinders and another set fires the other half. That's necessary, because, with a high-speed eight, it'd be mighty hard to make one set of points work fast enough and still get sufficient current through the coil for a fat spark. Point is, that if one set of contact points is out of time with the other, half the cylinders will get a late spark and they'll loaf on the job.

"You'll find that one set of contact points is fixed so you can only adjust the amount of the break. The other set is mounted on a plate so the whole business can be moved. Each breaker arm produces the spark in four of the cylinders. After you've set the fixed arm so it opens the right amount, the next job is to move the plate holding the other one till it breaks the same."

"How do you tell when you have it right?" Colonel Marrold asked.

"I was coming to that," said Gus. "There are a lot of ways. The simplest I know of for the fellow who does his own work is to open up the window that lets you see the timing marks on the flywheel. Then you take a long piece of spark plug cable and hook it on to the high tension cable from the spark coil that ordinarily sticks into the center hole of the distributor head. Bare a quarter of an inch or so of the cable and hold the end close to the metal right beside the opening to the flywheel.

"HAVE somebody turn the motor over slow with the ignition turned on. With the spark jumping right beside the inspection hole, it's a cinch to see whether the spark jumps as the timing mark on the flywheel comes under the pointer. If it's off for half the cylinders, move the breaker arm plate till you get it right."

"That sounds easy enough," Colonel Marrold admitted.

"It is easy," Gus maintained. "An eight-cylinder motor is simpler in some ways than a six because it is, after all, only two four-cylinder motors made into one. The ignition system is one example. On some cars, even if one breaker arm went out of commission, the motor would still run on four cylinders. Many of the eights really use two carburetors—one for each set of four cylinders. It looks like one carburetor because there's only one float bowl, but there are two mixing chambers and two needle valves that have to be adjusted separately."

"How is the best way to do that?" asked Colonel Marrold.

Gus smiled. "Easiest way I know of is to cut out half the cylinders while you adjust the low speed setting for the others. You can do that either by disconnecting one of the coil leads when there are two, or by wedging open one set of breaker points with a bit of thick cardboard."

REAL DETECTIVES BEAT HOLMES

(Continued from page 15)

microscopic bits of matter are always scrutinized carefully by the trained hunter of criminals. In one instance, the dust on a pair of shoes was examined steadily for fifteen hours in a laboratory. The evidence obtained resulted in a conviction.

In the West, a few years ago, the famous D'Autremont train robbery was solved through dust found in the pockets of a pair of overalls discarded by the fleeing bandit. The dust was from a peculiar-colored soil and indicated to railway detectives that the robber had come from a certain small area in a particular locality.

IN FRANCE, Edmund Locard, the famous scientific detective of Lyon, has catalogued hundreds of common dusts and worked out rapid tests to identify them. Similar to this catalogue of powdered particles is an atlas of fibers published for the benefit of detectives in 1929 by an English doctor. It records the characteristics of plant and animal hairs which, not infrequently, play an important part in detective work. What a microscopic examination of such bits of matter will reveal to an expert eye was dramatically illustrated in the quick solution of a bombing case in Berkeley, Calif.

Four sticks of dynamite, tied together with a cotton twine, had been found beside a house in the suburbs. The unexploded bomb was brought to the Berkeley headquarters and turned over to Dr. Albert Schneider, director of the police laboratory.

Removing the cotton string, he placed it in a container of clear water and shook it violently. Later, he poured off the liquid and examined the residue with a powerful microscope. As a result of this examination he was able to announce that the twine had come from a farm where there was a fast-running stream of water, pine trees, several varieties of shrubs, black and white rabbits, a bay horse, a light cream-colored cow, and Rhode Island Red chickens! Incredible as it seems, this apparently fantastic statement was later proved correct in every detail!

New apparatus and improved technique are constantly increasing the uncanny skill of such scientific bloodhounds of the law. Some of the recent aids that have been developed to speed up the work of trailing criminals are: folding compound microscopes for use in the field; portable arc lights providing illumination for hunting tiny clues at night; "pill box" cameras occupying little space and taking clear pictures on minute ribbons of film; electrically-operated tear-gas guns; and radio police cars, cruising the streets, ready to dash at fire-engine speed to the scene of a crime when an aerial message is flashed from headquarters.

Predictions for the future are that delicate instruments detecting lies by changes in breathing, blood pressure, and body electricity will replace the "third degree" and that a "walking and talking rogue's gallery" of sound movie films will replace the picture files of the present.

IN VIENNA, Austria, a rare plastic substance called "moulage" has recently been put to work helping detectives. It records in permanent form such fleeting evidence as fingerprints in dough, teeth marks in fruit, and footprints at the scene of a crime. This colloidal mixture has just been introduced into America by the Scientific Crime Detection Laboratory, where a special moulage room has been established in charge of an expert.

During the last year, rays of invisible light, such as the ultra-violet and the "black light" of the infra-red, have helped solve an increasingly number of crimes. Ultra-violet rays will detect almost instantly counterfeit bills, spurious gems, erasures in forged checks, and differences in dusts that appear alike.

Most substances, when struck by these mysterious rays, glow, or fluoresce, with a distinctive color. It is due to this fact that several murder mysteries have been solved in spectacular fashion. The most celebrated of these victories for ultra-violet light was in the strange case of "the man with the aspirin hair."

On the outskirts of Paris, France, the body of a woman who had been brutally murdered was found by the police. The only clue to the identity of her slayer was a small piece of hair which had caught under one finger nail as she grappled with her assailant. When this hair was placed under an ultra-violet light, a strange thing happened. It seemed to burst into purplish fire, glowing with the exact shade peculiar to aspirin.

IN TRACING the history of the woman, the police had picked up three suspects who might have had a motive for the killing. A hair from the head of each was brought to the laboratory and exposed to the ultra-violet rays. Two remained dull but the third, from the head of a man who took aspirin regularly in such quantities that it was given off by the scalp pores into the hair, burst into the purple, telltale sheen which marked him as the murderer.

A knowledge of metals, and the thousand and one alloys in common use, is frequently an ace card in the hands of the real-life Sherlock Holmes of today.

An unusual case of this sort occurred not long ago in Wisconsin. A farmer who owned a large cornfield bordering a railroad sued the transportation company for thousands of dollars, claiming his herd of blooded cattle had been killed through carelessness of the section crew. He maintained that the workmen, in laying new rails, had thrown the connecting wires they removed from the old ones over the fence into his cornfield. These wires, he said, got into the corn shocks and were cut into fine pieces in the feed choppers. As a result of eating the little pieces of metal, his complaint read, his whole herd died.

A SCIENTIFIC detective was called by the defendants. He analyzed the stomach content of several of the dead animals and found the bits of wire, just as the farmer had reported. He next took several to his laboratory and measured them. They were exactly the same diameter as those used on the rails. But, when he made a metallurgical examination of the death-bringing bits and of the standardized metal in the railroad connections, he found that, although they looked alike, they were of entirely different compositions. The farmer had purchased wire of the exact diameter of the rail connections, cut it up and fed it to his animals in a plot to mulct the company.

In this case, as in a host of others that will be reported in the succeeding articles of this series, the detective with the trained scientific mind played the stellar role.

Such men begin where the ordinary officer leaves off. Working slowly, painstakingly, utilizing every branch of science at hand, these modern man-hunters are arriving at astonishing solutions in baffling crimes. Their work is analytical, methodical; but their results are amazing, magical.

WATCH for the next installment of this vivid series. Learn of the amazing feats of modern crime detection in which human blood is the only clue. See POPULAR SCIENCE MONTLY *for September on sale August first.*

NIGHT FLYERS HURDLE THE ROCKIES

(Continued from page 33)

weighing 15,000 pounds when loaded, down in a comparatively small field. I recall test-flying the first of our eighteen-passenger ships. At Cheyenne, from a field 6,200 feet above sea level, I took the ship off with a 4,000-pound load after a run of 1,700 feet. By using the brakes, it could be stopped in a shorter distance. Normally the eighty-foot wings lift the plane after a run of less than 1,200 feet.

THE big ships never start out until expert mechanics have checked every moving part and examined them inside and out to assure themselves everything is perfect. The inspection sheet is more than a scrap of paper, for it assures the pilot that his ship and its engines are ready for eleven hours of steady flying over the 1,032 miles from Oakland to Cheyenne. Three times during that run, the plane lifts its load from sea level to 10,000 feet.

The planes withstand the rigors of cold and wind even better than the pilots. I leave the eastbound section at Reno after a flight of only 200 miles, but the plane continues on another nine hours to Cheyenne. Mountain flying may tire the pilots, but it does not slow down these flying parlor cars in their dashes across the states. While I rest at Reno awaiting the westbound section for my midnight return over the Hump, my ship roars on through the night another 800 miles with other pilots at the controls.

Undoubtedly the Sacramento-Reno run covers the toughest stretch in the world to be flown on schedule. Yet air mail planes have been crossing it for eleven years and no pilot has been seriously injured. Not a passenger has suffered from a forced landing.

Why is this night flying safe? At the outset passengers were not carried during the night runs. Not until the airway was lighted and the weather reporting service and radio communication were established did we plunge into the darkness with passengers. Now, not only are we guided by voices that come through radiophones into our ears, but each ship carries searchlights and flares that enable it to find a landing place.

Each night as one of the big planes moves out from the loading platform at Oakland, the landing lights cast their combined half-million-candlepower beams down the field to light up the runway. As they descend on any of the thirteen regular fields between Oakland and Chicago, the searchlights are ready to illuminate the field.

Three years ago not even the most optimistic pilots dreamed we ever would fly heated planes. Now hot air from the engines is carried through exhaust pipes to both the pilots' and passengers' cabins. Sixty-two electric lights illuminate the passenger cabin, the wing tips, and the tail.

WHILE the passengers doze, the chief pilot listens to weather advices and counts the minutes until he's due on the air for his report. Three times an hour in fair weather and every ten minutes if a storm threatens, I throw a switch and, speaking into the microphone strapped to my helmet, report our position and say that all's well.

With a tiny fountain-pen flashlight I compare two wrist watches to make sure I'll call in on the dot, for I have been taken to task for reporting thirty seconds too early. I watch the three engines to keep them synchronized. I watch oil pressures. I check our positions to make sure we're running on time. Then, out of the blackness ahead, the lights of Reno appear as tiny dots on a black canvas. We glide down to a landing. We're over the Hump.

Do Sharks Really Bite Human Beings?

(Continued from page 17)

anything but what they were, but no mention of them appeared in the local papers. Similarly, in communities along the Caribbean, the Gulf, and that portion of the Atlantic where dangerous fish are found, there is little disposition on the part of the press to publicize events that might prejudice possible visitors. It is not difficult, however, to uncover apparently authentic cases of shark bite.

It is true that the barracuda—a slim, swift, piscine torpedo—has been responsible for many injuries and deaths. Attracted by any moving object in the water, it speeds to the attack, biting at anything, not because it is hungry, but just for the sake of biting.

DOWN around the Florida keys, where barracuda swarm, it is sometimes impossible for a fisherman to pull a whole fish into his boat. Drawn by its struggles, barracuda chop it to pieces before it can be brought to gaff.

Even when the fisherman is pulling the head of his mutilated catch overside, a barracuda will leap clear of the water in a savage attempt to get that, too. When hooked himself, he is a lusty fighter, and woe betide the inexperienced angler who neglects to club him to death before bringing him aboard.

Two men, fishing from a rowboat recently, pulled in an apparently exhausted barracuda and forgot to tap him over the head. The next moment they took to the water, and let the barracuda have the boat to himself.

Ordinarily the shark is somewhat more lethargic than the barracuda. He is attracted to his prey by scent rather than by sight. The eyes of the barracuda are large and keen-sighted. Those of the shark are relatively small and their vision is poor. Of the two, the barracuda is by far the faster swimmer, his speed having been variously estimated at from twenty-five to seventy miles an hour, as against the shark's eight to nine.

Since no one, to my knowledge, has ever been in a position to hold a stop watch on the respective performances of either fish over a measured course, the speed of which each is capable is wholly a matter of conjecture. It would seem reasonable to suppose, however, that the known fact that the barracuda is fast and attracted by anything that makes a swirl in the water has led to the supposition that he is more dangerous to swimmers than the shark.

One factor that would appear to enhance the difficulty of identifying the miscreants in such cases is that the victims of predatory fish seldom see their assailants clearly.

NATURALLY, when a man has been bitten, his first thought is to get to shore. He does not look to see what has attacked him. If it happened to have been a shark, he might have caught a glimpse beforehand of its dorsal fin cutting through the water. But though the dangerous types of sharks are surface swimmers, they do not invariably stay on the surface. If the attacker were a barracuda, which has no large dorsal fin, it is improbable that the swimmer would see it at all.

Nevertheless, though their victims may not have seen them, it is said to be possible to tell, from an inspection of the wound, whether it was inflicted by a shark or a barracuda. The jaw formation and dental equipment of the two fish being utterly dissimilar, their bites are as unlike as those of a dog and a woodchuck. With its seven rows of thin, flat, triangular, saw-edged teeth, the shark is a ripper, a tearer of flesh. The barracuda, with long, razor-sharp fangs projecting from the roof of its mouth, and its jaws rimmed with smaller, needle-pointed teeth, is a slicer. The shark scrapes a jagged wound; the barracuda neatly cleaves.

A few varieties of the fish, it is true, can be definitely exonerated, these being the kind known as "bottom feeders," who have either no teeth at all, like the nurse shark, or teeth too small to do any damage. With these exceptions, however, all sharks, it is assumed, are potential man-eaters. The consensus of opinion among the authorities I have talked with is that sharks that attack men probably do so without actually knowing the nature of their quarry.

Observe that I say "probably." The truth is that compared with the mass of information available regarding the lives, habits, and so-called psychology of wild animals, there is relatively little definite knowledge concerning the equally wild denizens of the deep. Thus, for example, though we know pretty well what a lion may do under given conditions, we can't tell much about what a shark will do.

Hunters, zoologists, and animal trainers have had opportunities to study the behavior and characteristics of lions for many years. The motion picture camera has played a large part in making these researches possible; by means of it, the animals have been studied in their natural environment, unconscious of being under observation.

Submarine photography is still in its infancy. Already, however, it has exposed one ancient theory as a fallacy by showing that a shark does not have to turn on its back in order to bite. Eventually underwater photography will expose still other fallacies. The great obstacle will be the virtual impossibility of keeping one particular fish, or group of fish, under observation in a natural state.

SHARKS have voracious appetites. Their natural food consists of small fish such as mullet, bluefish, kingfish, and jacks. Their presence or absence in any particular locality is governed largely by the presence or absence of food. They trail the big schools that criss-cross the seas, harrying them much as wolves harry a panic-stricken flock of sheep. One of their peculiarities is that normally they do not attack healthy, vigorous fish. If they did they would long ago have cleaned out the oceans.

One can sometimes see sharks gliding lazily along, right in the midst of a school of mullet, say, apparently ignoring them. Actually they are on the lookout for stragglers. Sharks have an amazing, mysterious sense that enables them to detect anything amiss with another fish, whether of a different species or one of their own kind.

Let a fish be hooked by an angler, and if there is a shark in the vicinity he will go right after it. The smell of blood attracts him, and as soon as he sees the hooked fish he can tell, by the way it swims, that something's the matter with it. Smaller fish seem to know that sharks can't see very clearly at any distance, and for that reason, when pursued, swim in sharp zigzags, constantly changing their courses.

THE smell and taste of blood rouse sharks to a high pitch of ferocity. One minute you may see them loafing along among a school of mullet in seeming nonchalance, and the next instant they are enacting a scene of indescribable carnage. One shark will have bitten a smaller fish in two; whereupon, together with its suddenly frenzied companions, it will try to kill everything within reach. At such times, when the water is whipped to a crimson froth and the air just above glistens with the bodies of the pursued, leaping clear in the frantic effort to escape, battles royal among the sharks themselves are a common occurrence.

If there were always schools of smaller fish to feed on, it might be that sharks would never attack men. But these schools come and go, kept ever on the move, not only by the necessity of seeking their own food, but by hosts of enemies. Deprived of their natural sustenance, sharks will eat anything they can get.

They follow ships for the garbage, enter harbors, and lurk at river mouths and inlets for such fish or other fare as may be brought down by current or ebbing tide. They lie in wait, close in along the beaches, for random fish that may come along, disporting themselves in the surf. It is these stray, hungry mavericks, who for one reason or another have become separated from the pack, that are blamed for attacks on swimmers.

Before coming to Florida, I had been led to believe that dangerous fish do not come close in for fear of being beached. The fact is that in pursuit of food, they frequently beach themselves. Captain Herb Hiscock, now retired, who has fished these waters for many years, told me he had seen sharks beach themselves by the score. In answer to my question as to which he considered more dangerous, the shark or the barracuda, he nominated the shark. So did Captain Herman Gray, whose experience in fishing tropical waters covers twenty-five years.

SHARKS and barracuda are not the only bad news to be encountered in southern seas. There are also the sting rays and the moray eels and the Spanish men-o'-war, the latter being the "chambered nautilus" of mythology, a beautiful purple and cobalt blue jellyfish, contact with which produces an effect similar to scalding.

The sting ray is armed with a barbed bony lance near the root of its tail and, being a slimy beast, inflicts a highly poisonous wound. The moray eel lives in holes in the rocks. It is a powerful brute, sometimes attaining a length of six feet, and a big one is easily capable of severing a man's wrist or ankle. When hooked and landed morays, unless thoroughly clubbed, are bad medicine; for they will try to sink their teeth in everything in sight. Though both can inflict serious wounds, however, neither the sting ray nor the moray is likely to molest a man unless he molests it first.

BUYING THE PARTS FOR A TELEVISION RECEIVER

(Continued from page 46)

self-synchronizing devices. "I can either get a variable speed motor and use a self-synchronizer or adjust it to synchronous speed with my thumb, or use a synchronous motor and just receive those stations that are running on the same power line that supplies the power for my motor."

"Yes, but as far as the price is concerned there is little choice. The motor in either case, not figuring the price of the synchronizer, will be about $15. I'd suggest that you buy a variable speed motor and synchronize it in the beginning by the thumb method you speak of. Then, if you feel that the results make it worth while to spend more, you can build a self-synchronizer."

"TO COMPLETE the scanning mechanism I'll need a rheostat and a neon lamp," I said. "How much do they cost?"

"The rheostat shouldn't cost over $4 and neon lamps are from about $2.50 up, depending on the size of the plate."

"What has the size of the plate on the neon lamp got to do with the reception of images?" I asked.

"A whole lot," laughed the clerk. "The size of the plate in the tube determines the theoretical size of the image you receive. If you have a one inch square plate the largest image that you will be able to receive without the use of lenses will be one inch square. The size of the plate likewise limits the pitch of the spiral along which the holes are located on your disk."

I was learning things every minute. "What size lamp would you suggest?"

"Most of the sets on the market," he told me, "are using a one and one half inch plate neon lamp. You can buy a good grade of lamp that size for about $4."

"Then, as I figure it," I said, "the scanning mechanism, without a synchronizer, will cost unassembled about $25."

"OF COURSE," the clerk reminded me, "if you want to enlarge that image, as they do on most of the commercial sets, it will cost you from $3 to $5 for an enlarging lens, giving you a total of $30."

"In other words," I said, "the entire set—amplifier, receiver, and scanning mechanism—ought to cost not more than $50."

"Yes, if you have the tubes you need for the amplifier, rectifier, and detector. If you haven't, it will cost you about $7 more for those. Of course, I have only figured the prices roughly. It may be that when you actually go to buy the parts, you'll find that the total may be less. Remember, too, that these prices are for new parts."

So that night as I walked home I was loaded down with bundles of every size and shape. The bundles contained the following: one resistance coupled amplifier, one blank scanning disk, tubes for the amplifier and detector, parts for one short wave receiver with detector unit, one neon lamp, one motor, and a few accessories such as connecting lugs, wire, and solder. While I wasn't sure that I had all the parts I needed for my set I knew that I did have all the essentials and there was nothing to stop me from going downtown again to the radio stores to buy any small parts that I lacked.

Now I'm all set to build my first television receiver, and I'll let you know how I get along.

IN THE Home Workshop Department next month, George Waltz will tell you how he went about drilling the holes in the scanning disk. If you want to get in on this new and interesting field follow along with him and progress as he does.

CAN YOU TELL FOG FROM HAZE?

(Continued from page 39)

was falling in quantity, or looked as though precipitation from it was imminent. Now we are told that the term means only an insignificant little cloud that drifts along in the rain somewhere between the surface of the earth and the base of the heavy cloud out of which the rain is falling. Either this ancient and honorable name must go out of use altogether, or else be given to that unimportant little ragamuffin of a cloud the sailor calls scud.

Then, too, we felt as certain as one could be about anything that the good and appropriate term, cumulo-nimbus, had come to stay and meant a cumulus (woolpack or heaped-up) cloud from which rain was falling, and in which thunder and lightning nearly always occur. We now are asked to restrict this name to the cumulus cloud whose top has been, or is in the process of being, drawn out into a thin, fibrous sheet.

ALL of this is in spite of the fact that often a thunderstorm cloud, a cumulo-nimbus as heretofore called, may give much rain and yet produce no fibrous sheet above it at all. It is also true that occasionally a cumulus cloud may produce no rain but carry its high sheet of fibrous cloud.

It would be well, however, for the aviator to remember that, in middle latitudes, a cumulus cloud that is developing a high fibrous sheet is quite likely giving rain below, with thunder and lightning, and that the country under a cumulus cloud that has not begun to develop the fibrous sheet is apt to be free from rain.

The next monkey wrench from the committee disarranged the alto-stratus cloud. This term used to mean just what it says—a high flat cloud. Now we are asked to use this term only when portions of the cloud show some fibrous structure.

The cirro-cumulus cloud is a variety that many of us will insist that we know when we see. This cloud form is simply a field of many little balls and ripples; we call it a mackerel sky if the clouds are in orderly rows, and a curdle sky if they are numerous and without order. These clouds are high and too thin to hide the sun.

Again, our committee says that this thing that is a cirro-cumulus cloud must not be called cirro-cumulus unless it has been seen to be formed from a cirrus cloud or cirro-stratus; that is, from a thick or relatively dense cloud of fibrous form.

From this it may be seen that not all misunderstanding of weather terms comes from the layman alone. Among weather men themselves, much misunderstanding has its origin.

Another weather word that everyone uses most freely is humidity. Probably this is the most vaguely used of all weather terms. Most of us realize that water is somehow or other involved in its meaning, but just how, is not always clear. Certainly the air is not wet in the sense that our hands become wet when we wash them.

PERHAPS we can run the trouble down this way: Water can and does exist in the gaseous state as well as in the liquid and solid states. Furthermore, the amount of water that can occupy a given space in the form of a gas rapidly increases with increase of temperature. That is why, on hot days, we tell ourselves, "It isn't the heat so much as the humidity."

The expression humidity of the air, or humidity, for short, can mean any one of at least three different things. If you mean the amount of weight of water in the air per unit volume, you must say absolute humidity. If, however, as is more often the case, you mean the ratio of the amount of water vapor actually present per unit volume to the greatest amount that could exist in the same volume at the same temperature, it is necessary to say relative humidity.

Finally, we sometimes mean, when we say "humidity," the weight of the water vapor per unit weight of the moist air, in which case the proper expression is specific humidity. The term humidity, when qualified in any one of the above three ways, has a definite and useful meaning.

WHAT do we mean when we speak of fair weather? Certainly this term should be clearly understood, but not only do many persons not understand it, but seem inclined to refuse to learn its meaning. We may use as vague terms as we like when merely talking about the weather, but the few terse sentences of the forecaster certainly should be clearly and correctly understood by all who read or hear them.

These sentences, indeed, are clearly understood, for they are carefully constructed, but unfortunately they are not always correctly understood. The chief confusion arises from the forecaster's use of the word fair.

The trouble here comes from the fact that the forecaster and his audience have entirely different definitions for this simple word. The forecaster always means no rain; to us, it always means fair skies.

Hail and sleet give us much cause for misunderstanding.

According to British usage, and the custom of many in America, sleet is a mixture of rain and snow. They call the frozen raindrops hail, or winter hail. The railway engineer restricts the name sleet to the smoothish coats of ice which sometimes form on wires, steel rails, and other exposed objects. This sleet is called glaze by the Weather Bureau, and is the characteristic feature of an ice storm.

Farming is another profession that has led to many weather word muddles. Of the fallacies that have come from agriculture the one that has caused the most confusion is the practice of moon-farming; of planting things that fruit above the ground in the light of the moon and tubers that grow under the soil in the dark of the moon.

The farmer, wedded to this method of going about his business, must first decide what is the light of the moon, and what is the dark.

SOME say the dark of the moon is that brief time when the moon is not seen at all owing to its nearness to the sun, and light of the moon the three or four days centered around full moon. Others, while agreeing with this definition of dark, will insist that all the rest of the time is light of the moon. Still others, with equal assurance, will insist that the time the moon is waxing; that is, the time of the first and second quarters, is light of the moon, and that the time of its waning, the duration of the third and fourth quarters, is dark of the moon. Finally, there are many who recognize light of the moon to be all the days when the moon is above the horizon most of the forepart of the night, and all the rest of the time dark of the moon.

Here are three distinct and widely recognized definitions of dark of the moon, and four of light of the moon. What, then, can a poor moon-farmer do when up against such conflicting definitions as these? Nobody knows, though it is quite certain what he should do—forget the moon and plant when the ground is ready and the season right.

WHY SOME BABIES ARE BORN WITH TAILS

(Continued from page 20)

the young one, from birth, clings to its mother's fur with its little hands. The human baby can support its weight by one or two hands for several minutes at a time. The ability to do this is, of course, no longer of any use to it. After one month, it disappears, and does not return until several years later. It is obviously a vestige.

MR. MOK: Speaking of babies, I have noticed that a baby's feet are much more handlike than ours. They seem to be almost able to grasp things. Is that a vestige, too?

DR. GREGORY: Absolutely. It is a survival of the handlike feet of the apes and the monkeys. Perhaps you have also observed that a baby's big toe can be moved farther away from the other toes than it can in the feet of adults. That is part of the same thing. Like the ability to support itself by the hands, the handlike feature of the baby's feet fades away, though some months later.

MR. MOK: The vestiges that you have told me about, with the exception of the tail remnant and the ear muscles, are on the outside of the museum. Are there any more in the interior?

DR. GREGORY: Yes. The most notorious is the appendix or, to give it its official name, the vermiform, or worm-shaped, appendix. It is a continuation, usually one or two inches long, of the pouchlike downward projection at the beginning—that is, the lower part—of the large intestine.

MR. MOK: What use is it?

DR. GREGORY: It is of no use to anybody, except the surgeons who are paid to cut it out. Its loss is a different matter. That serves thousands of people as a topic of conversation.

MR. MOK: Why does it cause so much trouble?

DR. GREGORY: Because it is a blind alley. Matter that does not belong in it may get into it, remain there, and cause inflammation.

MR. MOK: What is it a remnant of?

DR. GREGORY: The part of our large intestine, shaped like a little bag, to which the appendix is attached, is called the *caecum*. Originally, this was a large and fully developed portion of the lower intestine. In some of our animal ancestors, especially the plant-eating ones, it was an important organ that served them as a sort of second stomach. The appendix was the finger-like end piece of this organ. In the meat-eating animals, the *caecum* is small. But many monkeys still have it fully developed. In some kinds, it is of enormous size.

MR. MOK: When did this second stomach disappear?

DR. GREGORY: In the apes. They are responsible for our appendix troubles. In them, the organ is reduced to a point where the big, manlike apes have it in a form similar to ours. In fact, the gorilla, the chimpanzee, and the orang-utan are the only mammals (outside of man) that have a true vermiform appendix. Now, all these vestiges that I have told you about are among the curiosities in your museum; but, as I said, there are two kinds of "exhibits"—curiosities and antiques.

MR. MOK: Is there any difference?

DR. GREGORY: Decidedly. A curiosity is something, either new or old, that excites interest but it is of no particular use. The "horseless buggy" we talked about last month is an example. An antique, however, is an article which, though ancient, may be in daily use. A table may date from the

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WHY SOME BABIES HAVE TAILS

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time of Queen Elizabeth and still serve you in your dining room. The vestiges are the curiosities in the human museum. They are old and interesting, but mostly useless.

MR. MOK: What are the antiques?

DR. GREGORY: All the other parts of your body. For instance, one of the most important and oldest in "point of service" is your digestive tract.

MR. MOK: How old is it?

DR. GREGORY: Literally it is as old as the hills, and much older than most hills; close to a half billion years.

MR. MOK: How did we get it?

DR. GREGORY: This fussy inner man of yours, that is kept satisfied only at great trouble and expense, is an elaboration of the lining in a jellyfish.

MR. MOK: I did not know that a jellyfish had any lining; much less that I inherited it.

DR. GREGORY: You did not inherit it directly. We got our digestive system from a long line of backboned animals leading back to the earliest fishes. They doubtless had a relatively simple digestive tract like that of your old friend, the shark.

MR. MOK: Has a shark the same kind of digestive system as a man?

DR. GREGORY: Basically, yes. All backboned animals—and the shark, you remember, is one of the least changed survivors of the oldest ones—have the same main divisions that we have: the mouth cavity, the throat, the gullet, the stomach, the small intestine, and the large intestine. The early fishes also had a liver, a gall bladder, a pancreas, and a spleen. The early digestive tract, consisting of throat, gullet, stomach, and intestine, is called the primitive gut. In practically all animals, the digestive tract is one long tube, swollen in some places, like the stomach, and folded up in loops in others, like the intestine. In other words, it is a continuous, nonsegmental structure.

MR. MOK: What came before that?

DR. GREGORY: We have to go back to the very early creatures to get at the origin of the digestive system. As I told you two months ago (P. S. M., June '31, p. 19), the first living things consisted of single cells. They divided. Then they formed ball-like colonies. These balls were hollow in the center. Much later, the ball began to sink in on one side, like a rubber ball with a dent in it. This pushed-in portion was the beginning of the primitive gut. The jellyfishes and spongelike creatures are pushed-in balls of this kind. The hollow in the center was surrounded by a double layer of cells. It was from the inner layer that the real gut was later developed.

MR. MOK: Ah, here we have the old lining!

DR. GREGORY: That's it. Later, a third layer appeared between the two primary layers. The spongelike creatures and jellyfishes still have only two layers. The lancelet—a small, eel-like forerunner of the fishes, about one inch long, that is still found on sandy shores in several spots along the Atlantic and Pacific—is the oldest living creature with three layers. Ernst Haeckel, the famous German zoologist, who died in 1919, worked out the theory that all creatures above the grade of sponges and jellyfishes, including you and me, are descendants of these ancient pushed-in balls. So, if you don't like the idea of having a jellyfish among your ancestors, you have only him to blame.

MR. MOK: How did the digestive system develop after that?

DR. GREGORY: The wormlike creatures already had a full-fledged digestive tract. Have you ever taken a worm apart?

MR. MOK: No, of course not.

DR. GREGORY: That's a pity, for a worm is a fascinating creature. If you had, you would know that it has a mouth, horny little jaws and teeth, and an intestine, beside many other interesting features. This is a true worm, the kind you use for fish bait. In the flatworms that live in the mud at the bottom of fresh-water ponds, the mouth is in the middle of the body, on the underside. This is because it is nothing but a lengthened and flattened jellyfish; the mouth is the entrance to the old primitive gut. All worms have glands that seem to perform the function of the liver in later animals. So, you see, we have had practically the same digestive system for the past four hundred million years, more or less.

MR. MOK: What of the lungs?

DR. GREGORY: They are a relatively modern invention—that is, compared to the digestive tract. Some of our early relatives breathed with their feet.

MR. MOK: What were they?

DR. GREGORY: I will come to them in a minute. The primitive water creatures did not need any breathing apparatus at all because, as I told you in our first talk, they took the oxygen from the water directly through their skin surface, just as the amoeba does to this day. As they required only a small amount of energy, they needed very little oxygen, and this system was sufficient to supply it. In everything above that grade, including worms, you will find various devices for increasing the oxygen-absorbing surface. The primitive backboneless creatures have little bags with folded sides, sometimes with tentaclelike prolongations. Many different creatures have made breathing organs out of almost any part of the surface of their bodies, simply by thinning it out and multiplying the blood vessels in it to promote the exchange of gases.

MR. MOK: How about those foot-breathers?

DR. GREGORY: They were a kind of sea worm. They had these little folded bags, or lobes, attached to their feet. They were richly charged with blood, and served as gills. The early fishes, however, used another part of their body for this purpose. They developed pouches in the throat which became folded up into loops. These pouches, abundantly supplied with blood vessels, gave rise to the gills as you know them.

MR. MOK: When did the lungs appear?

DR. GREGORY: In the air-breathing fishes. They developed another pair of pouches in the throat, just behind the gills. Those were the beginnings of our lungs. At first, they kept the gills, too. When the air-breathing fishes struggled out on to the land, the gills were no longer of use to them and eventually disappeared, while the lungs developed more and more.

MR. MOK: Why?

DR. GREGORY: Gills can operate only in water. Because they can appropriate oxygen only out of the water and not out of the atmosphere, they dry up on land. For that reason, the lung-fishes today come up to the surface of the water to breathe.

MR. MOK: Are there still air-breathing fishes?

DR. GREGORY: Certainly, and they have both lungs and gills. There is one kind in Australia, one in Africa, and one in South America. The African type is the most paradoxical fish you have ever heard of—it may

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drown! It dies if you keep it under water too long, because its gills have become deficient. These fishes not only have lungs, but legs—that is to say, well-muscled paddles. One of them, the South American, is a foot-breather, as you call it.

MR. MOK: *A fish that breathes with its feet?*

DR. GREGORY: In the words of Mr. Ripley, "believe it or not." This is a river fish. The female lays her eggs in a nest at the bottom of the river. That job done, she swims away and is never seen again. So it is up to father to guard the nest against hungry enemies.

MR. MOK: How can he when he is an air-breather and has to go up to the surface for his oxygen?

DR. GREGORY: That's just it. He cannot breathe down there with his deficient gills, and his lungs are no good to him. So he makes breathing-plumes out of his hind legs—that is, the hind paddles branch out into a kind of plumelike gills that extract oxygen from the water. To come back to the lungs: The early lung, and even the perfected lung, consists of a bushlike system of pockets, or buds. The essential purpose of the branching is to increase the oxygen absorbing surface.

MR. MOK: Where did our blood come from?

DR. GREGORY: From the sea. It is a much greater antique than the lungs; every bit as old as the digestive system.

MR. MOK: How could blood come from the sea?

DR. GREGORY: In the primitive water creatures, it was largely sea water with a sprinkling of chemicals. That is believed to be the reason for the presence of salt in your blood. It contains nine tenths of one percent of salts, and most of that is common kitchen or sea salt. It is very important, because it enables the blood ultimately to dissolve proteins—that is to say, the chemicals we take out of such foods as meat and eggs—and build them into our tissues. When the simplest animals first crawled out of the sea onto the land, it is probable that they took with them, in their bodies, a bagful of sea water.

MR. MOK: But what of red blood?

DR. GREGORY: Some of the lower types of creatures, such as jellyfishes, sponges, oysters, and clams, still have no red blood. It appeared first in the worms. The essential feature of the blood of backboned creatures (including the fishes) is that it has red corpuscles in the same sense as ours—that is, red cells that contain hemoglobin. That, in turn, contains oxide of iron that attracts oxygen and gives back carbon dioxide.

MR. MOK: When did blood first become warm?

DR. GREGORY: There really is no such thing as cold blood. There cannot be. You cannot have red blood without oxidation, and you cannot have oxidation without some heat, no matter how little. So, even the blood of the fishes is not entirely cold, as most people think it is. But warm blood, in the sense you mean, is the invention of the mammals.

MR. MOK: What makes it warm?

DR. GREGORY: In the mammals, the blood cells became much smaller in size but much larger in number and greater in efficiency. For instance, in every cubic centimeter of blood—that is, about one sixteenth of a cubic inch—a frog has from 250,000 to 2,000,000 red blood cells, while a man has from 4,000,000 to 5,000,000. The more red blood cells, the more oxidation; and the more oxidation, the more heat. This is most probably the reason why the body temperature of the mammals (and also of the birds) is so much higher than that of the earlier creatures; for example, the reptiles. It also accounts for the fact that they can regulate their body temperature so much better against variations outside, and against internal variations due to disease.

MR. MOK: And the heart?

DR. GREGORY: In the lower creatures, it began simply as a magnified blood vessel, a big artery. But, mind, the pumping principle was invented long before the heart itself.

MR. MOK: How did it begin?

DR. GREGORY: With the earliest sea creatures—those pushed-in balls. They pulsate with the outer layer of the entire body. Next time you are at the seaside, take a good look at a jellyfish, and you will see that it contracts on this principle. In the worms, the primitive heart still is an enlarged blood vessel. The true heart appeared first in the fishes hundreds of millions of years ago.

MR. MOK: Has it changed much since then?

DR. GREGORY: Not in principle. From the time of the air-breathing fishes, it has become a more and more elaborate piece of machinery. Except in minor details, we have the true mammal heart, like a dog, a cat, a cow, and a rabbit. The main difference is that we ascribe all sorts of functions to it which it does not perform. We have made it the seat of the emotions. It is nothing of the kind. It is a blood pump.

MR. MOK: Do the muscles also belong among the antiques?

DR. GREGORY: They certainly do. They are almost as old as the primitive gut, but not quite. Originally, they were the egg-laying machinery.

MR. MOK: Egg-laying?

DR. GREGORY: Yes. You remember I told you that the early pushed-in ball creatures had a double lining of cells, and that later a third layer appeared between the original two? Well, from this third layer, pouches budded off on either side of the primitive gut. From the first, they had the ability to contract and expand, to throw out the eggs of the creatures. This contracting power enabled the primitive animal to undulate—that is, to send waves along its body, and move forward in that way. That was the beginning of the muscles.

MR. MOK: And then?

DR. GREGORY: The early, pre-backboned fishes, of which the lancelet is a survivor, had a very simple kind of muscles. These became more elaborate in the fishes, and it is from them that we inherited our basic muscle structure.

MR. MOK: Where did we get our backbone?

DR. GREGORY: I will explain that to you the next time, when I will tell you the story of our upright position.

MR. MOK: Is that a story in itself?

DR. GREGORY: It is part of a very fascinating and intriguing story—our descent from the monkeys!

DID we ever really live in the trees? Next month, Dr. Gregory will tell how we climbed out of the branches and learned to walk on our hind feet. Here is the most thrilling chapter in Man's history, one of keen interest to every thinking person, set forth by one of the world's foremost authorities. Watch for it in the September issue of POPULAR SCIENCE MONTHLY, *on sale at all news stands on August 1.*

Daring Men Test Giant Rockets

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definitely settled in spite of the many experiments, is the best shape for the combustion chamber, and the materials from which it should be constructed. This chamber, which the Germans call the rocket motor, is the place in which the continuous driving explosions take place. From one end of it projects the slightly flaring nozzle through which rush the escaping gases.

The best shape so far discovered is cylindrical, with rounded ends, so that the inner chamber looks not greatly unlike an egg with both ends the same size. It has been learned that the fuel must be introduced at the lower end, near the exhaust nozzle, but in such a direction that it squirts upward, the streams of gasoline and oxygen meeting somewhere above the center.

ROCKET motors are now being built of aluminum or duralumin, with an inner lining of thin copper. They are surprisingly small for the power they yield, and this is one of their advantages, shared by no other motor. There are no moving parts, consequently no mechanical losses. A small rocket motor not much larger than an ordinary egg, weighing complete not much more than a quarter of a pound, will yield a "lift" of about twenty-five pounds, and can shoot a ten-pound rocket upward for twenty miles in little more than a minute.

It is difficult to calculate the actual horsepower generated by a rocket motor, since there is no revolving shaft from which the brake horsepower may be taken. Further, the faster a rocket goes the greater its efficiency. This theoretically approaches the maximum when the rocket motor is moving forward at the speed of the ejected gases. This may be in the neighborhood of a mile a second, and since to date no rocket has ever gone so fast, we must depend upon calculations alone to give us the horsepower generated by such an engine.

Dr. Paul Heylandt, a German experimenter, recently announced that he had built a rocket motor weighing fourteen pounds capable of delivering 200 horsepower. A gasoline motor of the same power would weigh between 250 and 350 pounds—a comparison which shows the enormous advantage of rocket power in craft that require light engines.

Dr. Heylandt's motor, attached to a specially constructed automobile, was tried out at Tempelhof air field. Burning a fuel consisting of liquid oxygen and gasoline, it emitted a roar that startled persons two miles away and sent the car forward at a terrific speed.

THE fact that vehicles such as automobiles and ordinary airplanes are structurally incapable of traveling at speeds sufficient to utilize the full efficiency of rocket motors may forever prevent the employment of this method of propulsion for such machines. Rocket vehicles will have to be streamlined to the last degree, perhaps shaped like military torpedoes.

In fact it was a ship of just this type that was recently described by Harold A. Danne, one of the aeronautical engineers in America who has given his attention to the problem. The transatlantic rocket ship will have a water-tight and air-tight cabin. The wings and landing gear will be drawn into the body when the craft is in full flight, and it will go roaring through the upper strata of the atmosphere at a calculated speed of 3,000 miles an hour or more, with a spear of bluish-white fire streaming out behind. These ships will have to be equipped with special navigating apparatus, probably devices like modern compensating artillery gun sights, to permit steering by the fixed stars.

Such flyers will make the journey from New York to Paris in an hour or an hour and a half. Los Angeles will be only about an hour away from New York. Commuters from San Francisco can go daily to their jobs in Chicago.

Before these wonders come to pass, however, a stupendous amount of work must be done. We are still in the first stage of rocketry, and a large portion of the work is now being done not with actual rockets, but on what technicians call the "proving stand"—a set-up on which rocket motors can be tested as to lift and efficiency without going to the trouble or expense of building the entire rocket. Less spectacular than actual rocket shots, the proving stand work is nevertheless extremely important at this stage.

LIQUID fuel rockets consist of three parts—the tanks for fuel together with the necessary feed lines and valves, the motor or combustion chamber and its nozzle, and the "pay-load" compartment, which in small rockets includes the instruments, such as the barometer, thermometer, and camera sent up to record a picture of conditions at high altitudes, and the parachute or other landing gear.

Each part presents innumerable unsettled problems. The tanks must be arranged so as to give the rocket complete balance in flight, whether they are full or empty and in all stages between. The pay-load must be light, compact, and able to withstand shocks, and its compartment must be so placed as not to disturb the balance of the rocket. The motor must be of just the proper size and shape to get the most out of the fuel that can be carried, else the rocket will fall short of its mark, or worse yet, explode.

At the German rocket flying field an elaborate technique has been worked out for making and testing rocket motors on the proving stand. This work is necessarily dangerous, and every precaution is taken to have all workers in safety behind embankments during tests. The fuels are turned on by remote control, and the lift of the rocket motor is automatically recorded by a special clockwork device.

A series of experiments along this same line will soon be started near New York by the American Interplanetary Society, the organization in this country that corresponds to the German society. Several individual Americans, particularly Dr. Robert H. Goddard, are also carrying on experiments with rockets. Dr. Goddard is now devoting his full time to rocket experiments at Roswell, N. M., under a grant of $100,000 made by the late Simon Guggenheim.

ANOTHER American at work on the problem of adapting liquid fuels to rocket motors is Harry W. Bull, of Syracuse, N. Y., a student at Syracuse University who gained international attention by his experiments with a rocket sled last spring. Bull is now making use of the laboratories of the university to develop a powerful rocket motor, and may later build a rocket making use of his discoveries.

These are by no means the only Americans who are working on this fascinating new problem in this country and abroad. In Vienna, the American physicist, Dr. Darwin O. Lyon, is reported to be building a new rocket, following the accident that destroyed his attempt at Mt. Redorta, in Italy, last year. Several universities and technical schools in this country have now begun to turn their attention to rockets, and it is likely that several students of engineering will make a mark for themselves in the near future with discoveries now on the way.

Americans must hurry if they are to compete in this field with the engineers of Europe. There are now four European groups organized to further rocket study, and all are headed by engineers, scientists, or mathematicians. The president of the German Verein für Raumschiffahrt is Professor Hermann Oberth, internationally known rocketor. A new organization has recently been formed at Vienna under the leadership of Guido Baron von Pirque, one of the foremost engineers of Austria.

IN LENINGRAD there is a group headed by Professor Nikolas Rynin, mathematician and engineer, and in France a committee of members of the French Astronomical Society annually awards the international Rep-Hirsch prize of 10,000 francs for the furtherance of astronautics, as the new science of space navigation has been called. This prize is made possible by the interest and generosity of Andre Hirsch, the French banker, and Robert Esnault-Pelterie, author of *L'Astronautique*, an aeronautical engineer of international reputation.

Perhaps never before in the history of science, with the possible exception of radio, has a projected development of this kind attracted so much popular attention, or enlisted so many enthusiasts. In Europe more than 1,000 persons belong to the various societies and contribute regularly to the experiments. In this country we have not heard so much of rocketry, but already there are several hundred enthusiasts organizing to begin experiments on an important scale.

Perhaps the day of huge space-ships flying to the moon is still a considerable distance away, but it is reasonable to believe that persons now living will see rockets cross the ocean with freight, and perhaps even passengers. It is not impossible, with so many working on the problem, that all of these things will come even sooner than we think. Rockets may be crossing the ocean yet in this decade.

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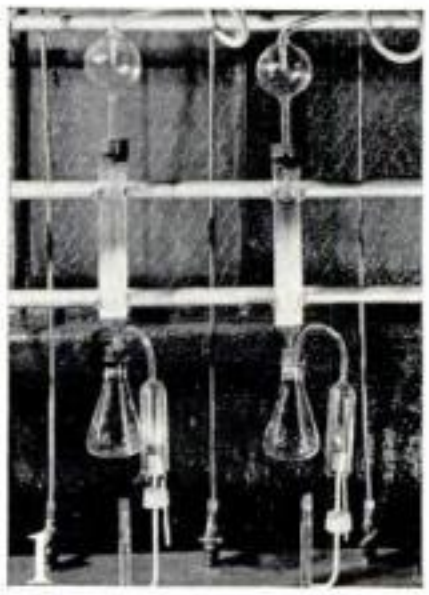
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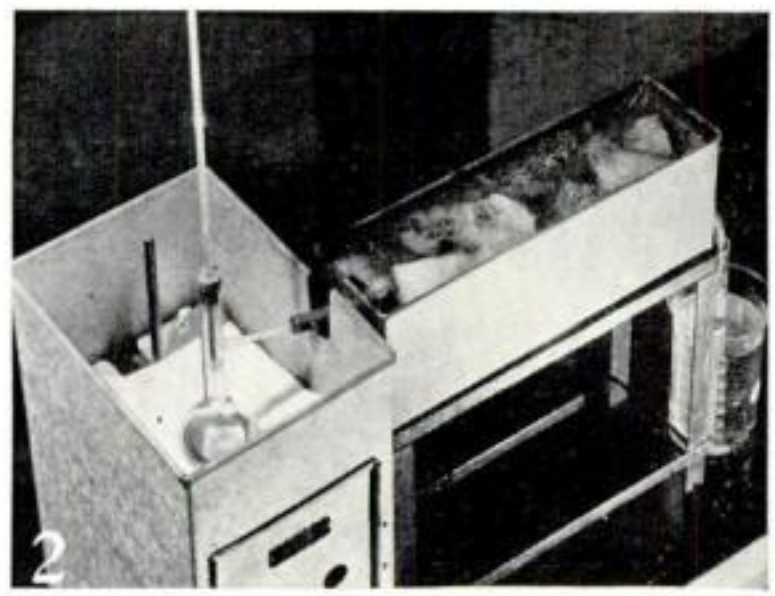
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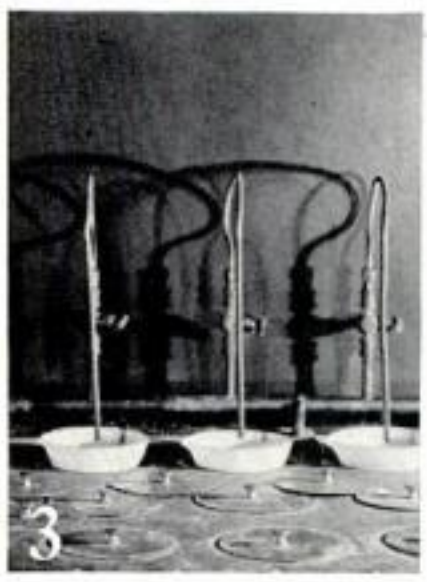
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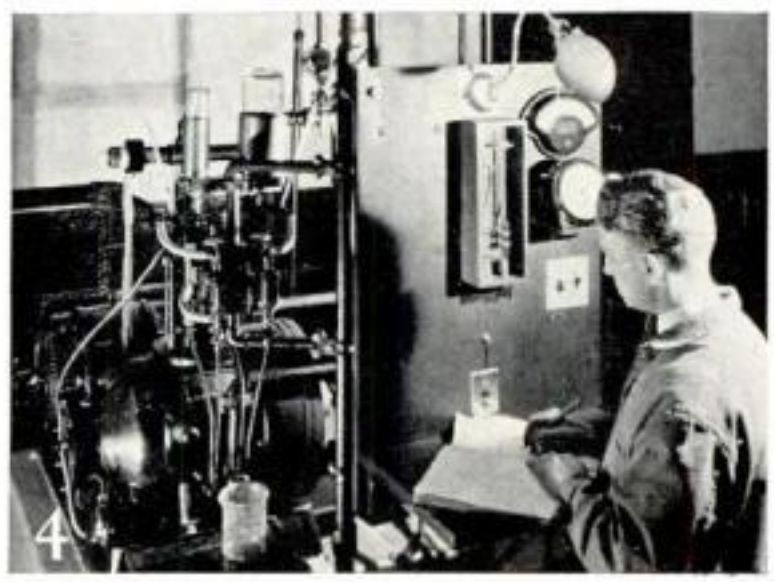
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